Concrete

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# Concrete Production Control

## An Analysis of the Requirements for Concrete Production Control in the Field, from the Standpoint of Quality and Economy—Factors Affecting Quality and Economy —Their Interrelation

By JOSEPH A. KITTS

THE character of concrete production control described herein has been maintained daily on the production of 652,000 cubic yards of various purpose concretes, with unusual results in quality with economy, on projects in California involving 1,000 to 450,000 cubic yards.

In introducing the subject of requirements of concrete production control, it is necessary to point out the little appreciated fact that the intricacies of the manufacture of concrete of *quality with economy* are as complex as those of structural design or those of the maunfacture of cement, steel and other products. Concrete must be made of various aggregates of various maximum sizes, for various strengths, densities, weights, for ice, chemical and wear resistance, etc., and of varying workability, flowability and cohesion of the fresh mix.

Considering strength as the only requirement, some measure of strength may be maintained by empirical methods, the most important of which is the maintenance of a particular water-cement ratio. Both economy and strength, however, cannot be maintained by anything as simple as water-cement ratio control. Strength, density, weight, wear resistance, workability, etc., *with economy,* depend upon some or all of the following:

Cement quality,
Cement content,
Water-cement ratio,
Quality of aggregates,
Shape of aggregates,
Maximum size of aggregates,
Coarseness or fineness modulus of aggregates,
Surface area of aggregates,
Uniformity of grading of mixed aggregate,
Character of uniform grading of mixed aggregate,
Cement to voids in mixed aggregate,
Cement to voids in fine aggregate,
Sand to voids in coarse aggregate,
Mortar to voids in coarse aggregate,
Accuracy of measurement of aggregates, cement and water,
Mixing time and efficiency of mixer,
Temperature of curing,
Moisture of curing,
Efficiency of placing plant, and
Workmanship in mixing, placing, and curing.

Economical mixtures of the required quality depend upon the utilization, to the fullest possible extent, of those conditions listed which economically benefit that quality. This means thorough, constant and understanding technical and practical control of aggregate and of concrete production, proportioning, mixing, placing and curing, in co-ordination with and supported by, cement, aggregate and concrete testing as a routine part of such control.

### Control Pays for Itself

The difference between the amount of cement required by arbitrary or empirical proportioning and that by complete technical control, for the same quality, is from 1/3 to 1 cubic foot per cubic yard of concrete or about $0.25 to $0.75 per cubic yard economy by thorough technical control. This pays the cost of thorough control on small and many times over on large projects. Where 100 cubic yards or more per day are being placed, a laboratory and thorough control may be maintained with economy and with the advantage that the uniform quality in strength, density, wear resistance, etc., is constantly insured and that the tested quality of the concrete is known before it is placed.

Thorough control of concrete production includes constant laboratory control and research tests on the job and at the aggregate plant in co-ordination with the mixing, placing and curing inspection, and the testing and proof of cement, before delivered on the job, and at such times as may be necessary to detect deterioration. The essential control measures for quality concrete with economy are enumerated as follows:

1

Specifications for concrete requirements, for cements, aggregates, plant, mixing, placing, curing, and for testing, inspection and control supervision.

It is desirable and is becoming a general practice that the owner supply the cement (or pay for it separately) and take the responsibility of production control and results.

2

Installation of adequately equipped testing laboratories:

(a) An aggregate testing laboratory at the aggregate plant (for major projects);

(b) A central cement, aggregate and concrete testing

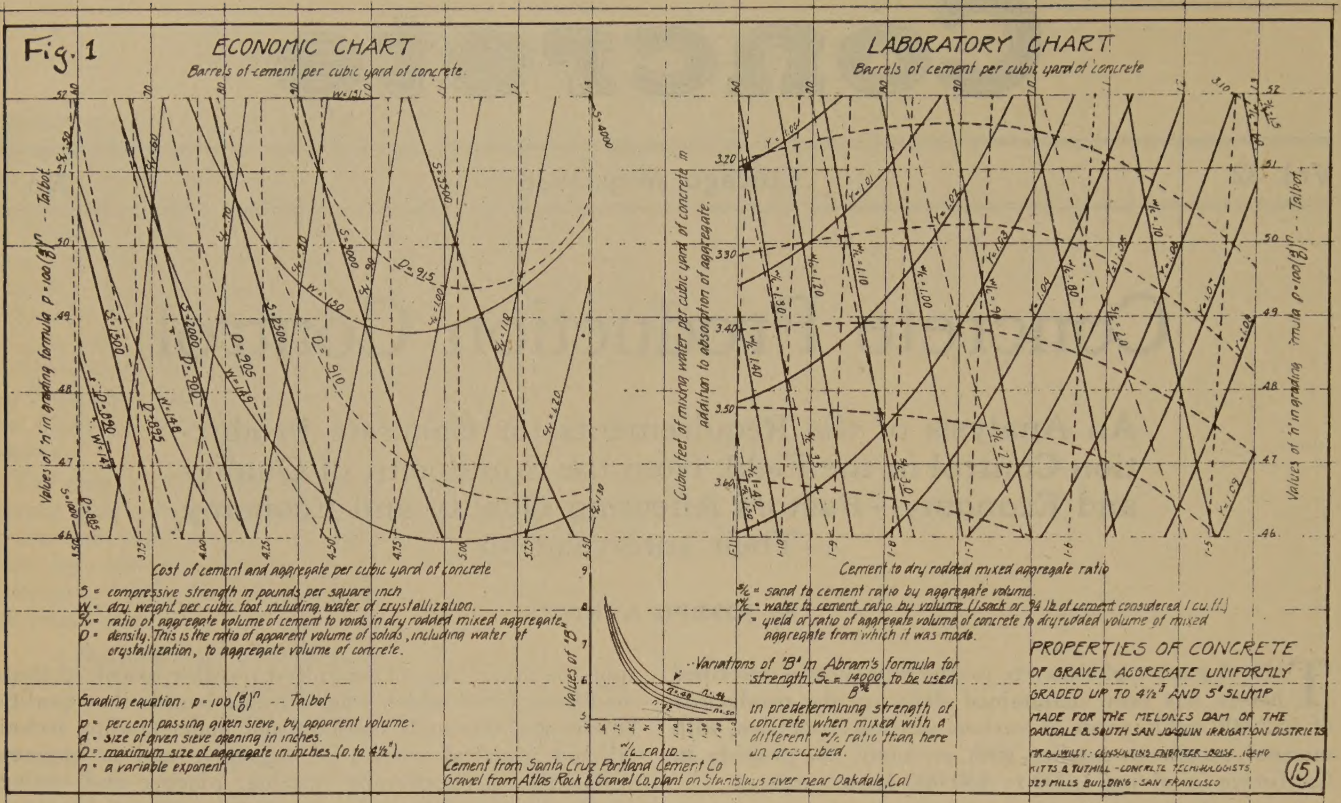

*Figure* 1

laboratory at the major structure of the projects; and

(c) Field laboratories for moisture tests of aggregates, for slump or workability tests of the concrete, and for the making and preliminary curing of test specimens.

### 3

Tests of aggregates for density, specific gravity, weight, grading analysis, fineness modulus, moisture content, absorption, bulking by loose measure and moisture and in inundation, for silt, organic matter and inferior material; and mineral classification of rock particles.

The procedure of testing and calculation must be a simplified and co-ordinated one eliminating duplication of test measurements and of calculations. It is neither economical nor expedient to test for weight per cubic foot, then for density, then for specific gravity, etc., as the labor of handling, of measurement and of calculation, is increased a number of times over that actually required by a co-ordinated test procedure. A comprehensive and simplified development of the physico-mathematics involved is essential to expedient and economical calculation of results from the test measurements.

### 4

Proportioning and testing of aggregate mixtures:

Having given certain aggregates, the combination or the *coarseness and particular uniformity of grading of them*, is the feature of control determining the quality and economy of the concrete, for, upon it depends:

(a) The strength, density, weight, wear resistance, workability, flowability, and cohesion for a particular cement content and water-cement ratio;

(b) The water-cement ratio for a particular cement content and consistency; and, therefore,

(c) Quality with economy depends upon the utilization of that particular uniformity and coarseness of grading of aggregate which will produce the required strength, density, workability, etc., with the least cement content.

This grading and cement content can be determined only by comprehensive tests, and it can be maintained only by constant testing of the aggregates as received on the job, from day to day, and modification of the individual proportions accordingly as the physical characteristics of the aggregates change.

Uniformity of grading should be expressed by a grading curve equation (providing for variation of fineness modulus) such as the Kitts-Peugh equation, $r = \frac{1-(d/D)m}{1-(a/D)m}$, in which $r$ is proportion by absolute volume retained on screen openings of $d$ inches, $D$ and $a$ are maximum and minimum sizes, respectively, of the mixed aggregate, and $m$ is an exponent.

Other essentials are: an expedient algebraic method of calculating proportions of the several sizes of aggregates to fit the grading curve; a simplified test procedure for determination of the density and yield of the combined aggregate; and, a developed physico-mathematics for the determination of the various physical characteristics and relations of the combination and for the determination of proportions by weight, and by actual, dry-rodded, loose-moist measured or inundated volume.

### 5

Mortar and concrete proportioning and testing:

This includes requirements (3) and (4) and, in order to select the most economical mixture of the required property, maximum size of aggregate, and consistency—concrete mixtures should be made of various gradings (coarseness and uniformity) of aggregates as tested under (4), and of various cement to mixed aggregates ratios, and same tested for the required properties. The results should be shown graphically as per Fig. 1 herewith.

Knowing the weights and actual volumes of water, cement and aggregate used in the mix, it is possible, by simply weighing any known volume of the mix, to determine the yield, density and weight per cubic foot, and, the water-cement, cement-voids, barrels of cement per cubic yard of concrete, and other ratios, may be readily calculated from the known facts.

The proof of the strength of the concrete depends upon measured breaking tests of the specimens at various ages. These indicate to a practical extent the results which may be expected under the same conditions of aggregate grading, cement content, water-cement ratio, and of placing and curing conditions. Tests from day to day are essential to check the results, to detect any flaw in proportioning and mixing operations, and to maintain a proper record of the quality of production.

**6**

Recalculation and change of proportions as required by change of physical characteristics of the individual aggregates, etc., in order to maintain the uniformity of grading and cement content:

The new mix should be duplicated in the laboratory and tested to prove the physical characteristics expected of that particular grading and cement content.

**7**

Co-ordination of laboratory and field measurements by weight and by actual, dry-rodded, loose-moist measured or inundated volume; calibration and adjustment of batchers, inundators, weighing devices, water tanks, etc.

**8**

Inspection of measuring, quantities, mixing time, workmanship of placing and of curing.

**9**

Field tests for slump, workability or flowability and the making of test specimens.

**10**

Organization, co-ordination and supervision of laboratory testing and field control, and maintenance of test and production records.

### Control Not Difficult

The required control procedure or manufacturing process is much less complex to the initiated than the outline would indicate. It becomes very simple by co-ordination and systematization of the test operations. The physics and mathematics required are simple and fundamental, and all calculations are expedient. The apparatus required for the physical tests of aggregates and mixtures are simple and inexpensive.

The only empirical theory proposed for use is that of uniformity of grading of the mixed aggregate and this is one well supported by experience. The procedure should give attention to all the theories of proportioning and provide complete physical data for analysis with reference to any theory.

The important results to be expected are that this research procedure may be maintained on concrete production with actual savings in cost over empirical control with greater uniformity in the required quality of product, with assurance of the quality before placing, and, the accumulation of research data continuously develops a more advanced knowledge and makes possible further economies and better quality.

## Cast Stone Manufacturers Organized and Working on Specifications

An invitation has been extended to cast stone manufacturers who are not already members to join the new Association of Cast Stone Manufacturers.

A constitution and by-laws are being formulated by the Organization Committee. The committee on specifications is to meet shortly to discuss a tentative specification and methods of submitting it to manufacturers.

The Association of Cast Stone Manufacturers was formed in Philadelphia, Pennsylvania, on February 29th. Thirty-two of the most important cast stone firms throughout the country were represented at that time and enrolled as charter members.

At this, the first meeting of the association, four very definite things were accomplished. Officers were elected, the amount of the annual dues was determined, an organization committee was appointed to work out a constitution and by-laws for the association and determine the advisable fields for its activities, and a second committee was appointed to co-operate with the committee of the American Concrete Institute in attempting to arrive at some form of definite specification for cast stone.

After considerable discussion the amount of the annual dues for the first year was finally set at a figure sufficiently substantial to make ample provision for the necessary organization work. It was assumed that after the first year the dues would be revised to fit whatever program the association might determine upon.

No general agreement as to what constitutes a proper specification for cast stone was arrived at the first meeting. But the general feeling seemed to be in favor of a rather rigid specification, and no serious doubt was expressed but that the specification arrived at by the American Concrete Institute committee would in all probability fit in with the requirements of the industry.

The officers of the new association are: president, C. Van de Bogart, Economy Concrete Co., New Haven, Conn., first vice-president, Wm. P. Eddy, Onondaga Litholite Co., Syracuse, N. Y.; second vice-president, M. A. Arnold, Arnold Stone Co., Jacksonville, Fla.; secretary, Frank M. Brooks, Brooks Art Stone Corp., Pasadena, Calif.; treasurer, Paul Formigli, Formigli Architectural Stone Co., Philadelphia, Pa.

No decision was reached as to when the association would hold its next meeting, but it was generally understood that it would meet again at the same time and place as the American Concrete Institute, regardless of whether or not an additional meeting be held previous to that time.

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## March Construction Figures Top Record

Building operation in March continued the stride which in 1927 began the establishment of a new twelve-month record, according to statistics just compiled by the Associated General Contractors of America. Surprise was expressed by some of the closest observers of the industry when March operation figures were seen to reach the largest total ever recorded for the month of March.

Contracts to the amount of $592,567,000 were awarded last month in the 37 states east of the Rocky mountains, according to the F. W. Dodge Corporation. This figure represents about 91 per cent of the national construction. There was an increase of 27 per cent over the total for February, 1928, but a drop of 5 per cent from the March, 1927 record,

**P. G. RILEY**
**President**

**P. G. RILEY**
**GENERAL CONTRACTOR**
~~701 Temple Street, Pittstown, N. J.~~

**T. G. McGOVERN**
**General Supt.**

Los Angeles

Dear Mac:

It's no use—I can control my legs, but can't keep this mind of mine from wandering back to the old job. You don't mind, do you? I know I promised to keep my hands off of the business and will, but the old bean will work and if I do not write about things that interest me, my letters to you would be about golf, which doesn't interest you at all, or about the weather, a subject that is much overdone.

Even my legs at times become uncontrollable and take me to some nearby construction job, and yesterday, what do you think, I was wandering around on a good sized job out here and unconsciously was about to bawl out the superintendent, when the contractor drove up and there was Ed. Wagner, one of my first superintendents. After he darned near knocked me over with a slap on my back, he took me over to the job.

The equipment he had on this job made me want to swear—new but cheap. He saw something was wrong with me and asked if my blood pressure was O. K. and I said, "Ed, for the love of Pete, why did you buy that machine?"

He answered, "I got a good trade-in deal—disposed of a lot of junk," and I said, "Yep, and got some more junk."

We went to lunch together and while at lunch, Ed showed me a watch he had bought. He sure was proud of that watch. He told me how many jewels it had, twenty-three I believe, explained all about the works, the solid gold case, etc. He knew every part of that watch. Said it cost him a lot of money, but he didn't care, it was made to keep time and did.

His car, too, he said was a humdinger. You should have heard him tell me about it. He told me more than any high-pressure car salesman that ever worked on me and said that was the best car he could buy.

What I am leading up to is this: When it came to picking out the equipment to place on his job to make money for him, he didn't look into what the machine would do and how it would stand up, but was influenced entirely by the trade-in figure offered to him for his junk. Ed could have bought a 7-jewel watch at a 7-jewel price and it would have kept 7-jewel time. He could have bought a 23-jewel shovel for this job of his at a 23-jewel price and it would have done him a 23-jewel job and paid him a 23-jewel profit that would have more than paid him for his junk, which he thought he sold, but which he really bought.

Why the devil a man who won't buy an automobile without knowing its horsepower, its speed and its durability, will buy a machine to place on his job, without being sure of these same qualities, I cannot see. Whether it's a shovel, a concrete mixer or a wheelbarrow, the best is the cheapest, no matter what the buying price is, and the man with the largest offer for trade-in junk is the man to be suspicious of, because he knows as well as you do, that it is junk and usually the thing he gives you in trade will cause you to start that expensive game with the repair man, "Now you have it—now he has it—now you have it—now he has it, etc."

Nope, my liver is O. K. The fact is, when I write to you like this, you should know I am back to normal.

Sincerely yours,

P. G.

*NOTE*

*P. G. Riley, or P. G. as some of his friends call him, is a hard-headed, close figuring, shrewd and honest contractor who has retired from the active management of his business, leaving Anna Ryan, his faithful and efficient secretary, to manage the office and Tom McGovern, whom he calls "Mac," one of his youngest superintendents, to manage the operating end.*

*P. G. has gone to California to take it easy and like a fire horse put out to pasture spends some of his time looking longingly toward the city, yearning to get back into the strife.*

*In his letters to his young friend Mac and occasionally to Anna Ryan he secures a triple advantage. He lets off steam, causes the young people to keep him in touch with the business and is able to give bits of advice gained from his own experience and also gained by getting, as he says, "a bird's-eye view now of the business"—advice that should be of definite use to the young people now carrying on his business and maybe to other contractors who are now given the privilege of reading this one-sided correspondence.*

*As David Harum said, "There's as much human nature in some folks as there is in others if not more." And possibly P. G.'s human nature which shows in these letters will make them of interest to our readers.*

# Ten Million Units Made Per Year in Washington, D. C., Products Plant

CONCRETE
EASCO
PRODUCTS

***Concrete Block, Tile, Brick and Trimstone Made in the Edmonds Art Stone Company's Modern Plant—Progressive Management Develops Market for Over Ten Million Units Per Year—Merchandising Methods—Plant Layout Based on Operation Economies***

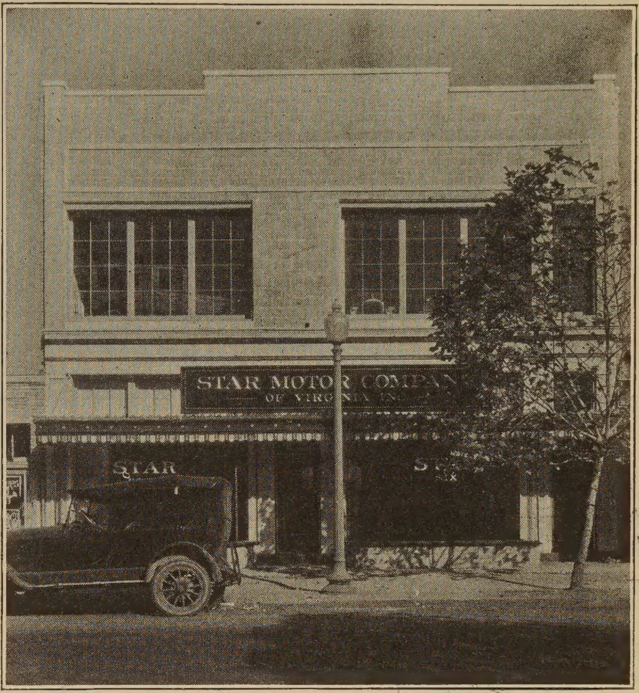
THERE are in the United States 26 concrete products plants in the million class—plants that in 1927 each produced concrete building units equal to or exceeding in wall volume a million 8- by 8- by 16-inch block. Each of these plants, in the majority of cases, specialized in one particular unit—block, brick, or tile.

In Washington, D. C., there is a modern plant with a productive capacity of over ten million units per year, divided into daily capacity as follows: 4,100 8- by 8- by 16-inch block, 10,000 5- by 8- by 12-inch tile and 20,000 standard brick, besides a considerable daily output of architectural trimstone.

This is the plant of the Edmonds Art Stone Co., representing one of the most significant developments in the progress of the concrete products industry since the war. It typifies the new spirit of the industry. It demonstrates the economic soundness of the concrete products business when that business has the benefit of the experienced management of progressive business men.

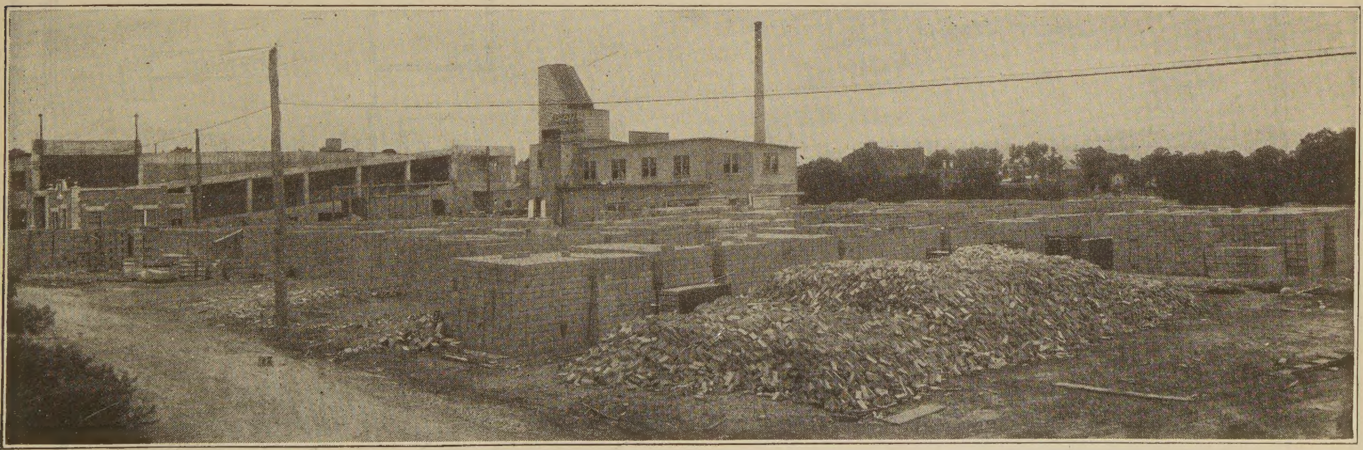
The Edmonds plant is remarkable on three counts—the size of its output, the variety of its products and the efficiency with which the manufacturing operation is conducted.

"The establishment of a business such as we had in mind," said E. S. Rowzee, president, "required the investment of considerable capital. We approached the problem in exactly the same manner as another group of investors might consider the establishment of a steel mill, or a factory for the production of cotton goods. A careful analysis was made of the local market for building products. We carefully estimated the present and future capacity for the market to absorb our output.

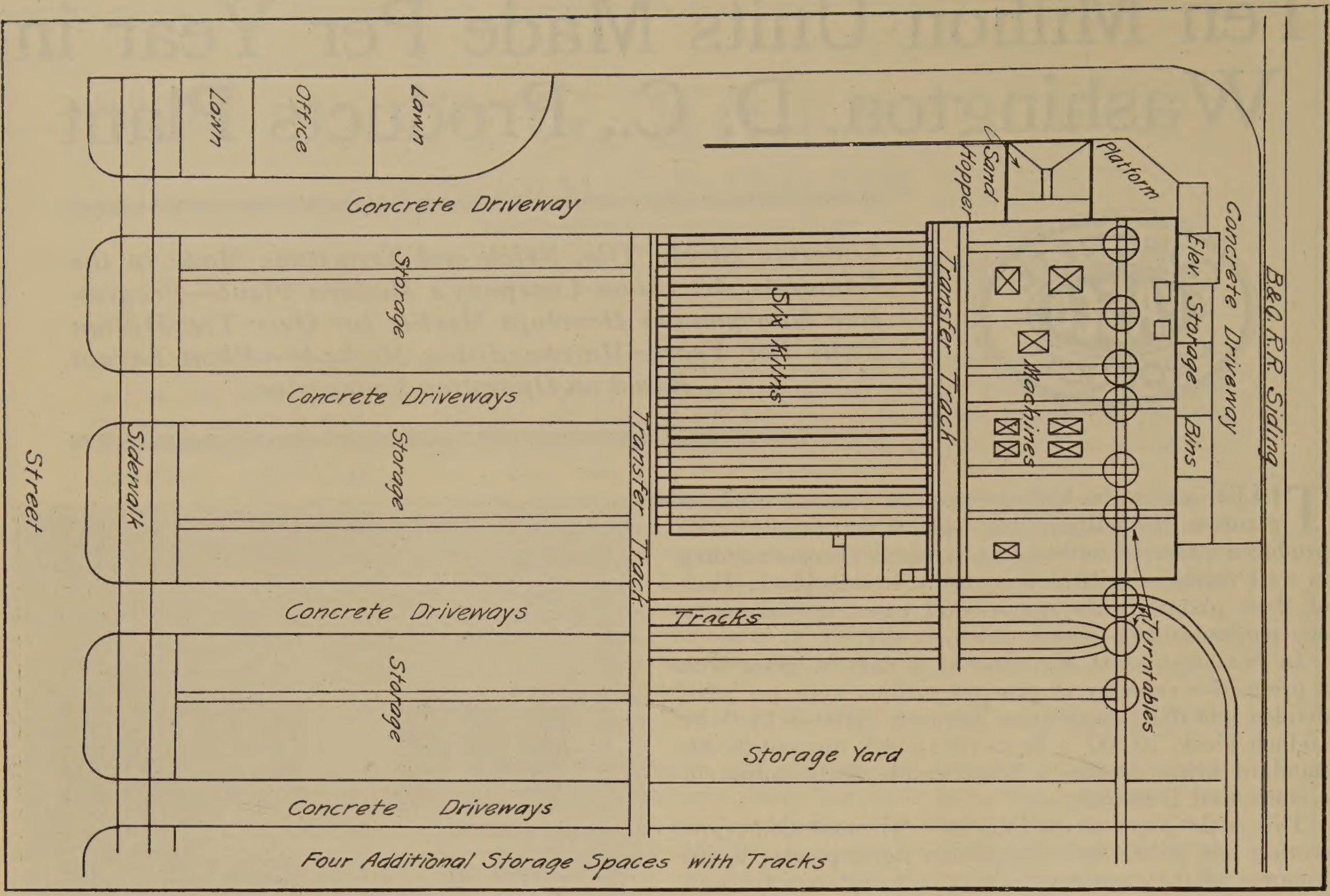


*Easco concrete block and cast stone trim were used in this attractive garage and salesroom*

"The available raw materials were examined carefully. These consist chiefly of sand, gravel, black slag, crushed marble and cement. Their quality and their availability

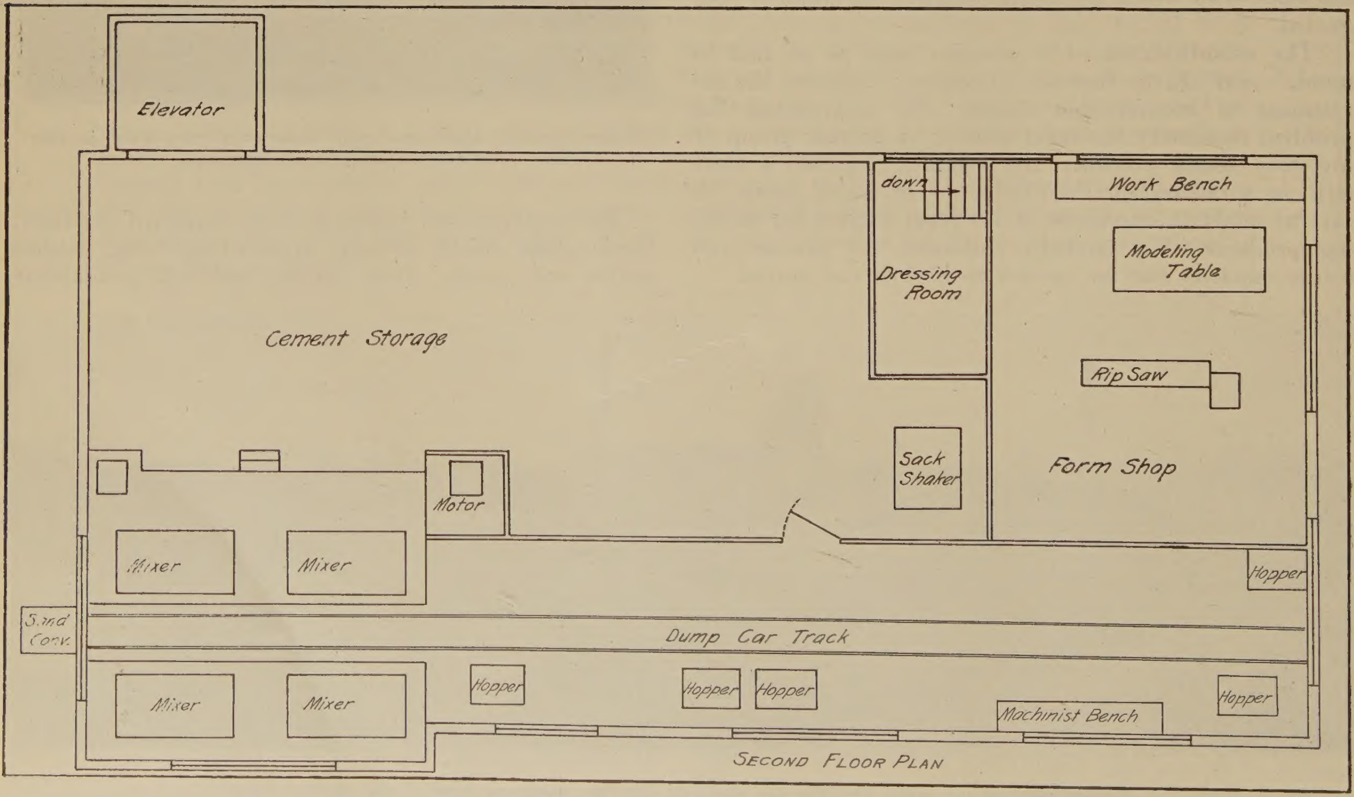


*Partial view of the plant, showing the stock of concrete block on hand in the storage yard*



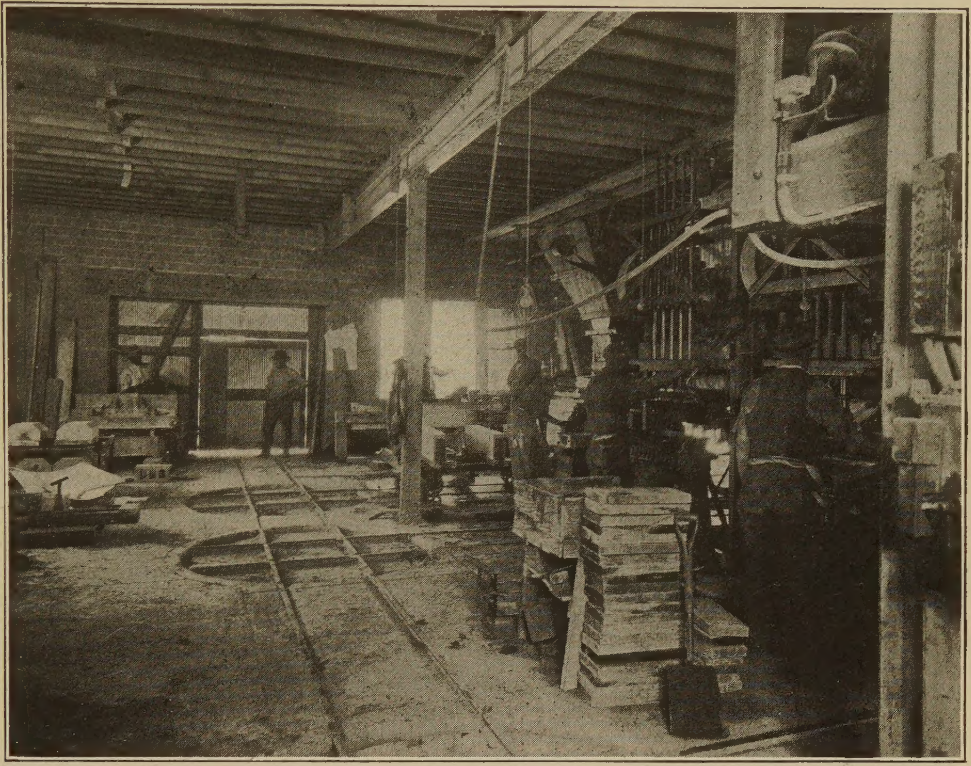
*General plant layout*

had our attention. Our site was selected with a view to the economical receipt of these raw materials and the delivery of our finished product. The plant is located on Queen's Chapel Road, N. E., in an industrial zone within the limits of the District of Columbia with a main line B. & O. siding and within 500 feet of the Pennsylvania



*Second floor of the plant*

R. R. It lies between two main boulevards into the city of Washington, giving easy access to all parts of the District and within 500 feet of a paved trunk highway leading south to Richmond and down the east coast and north through Philadelphia to New York."



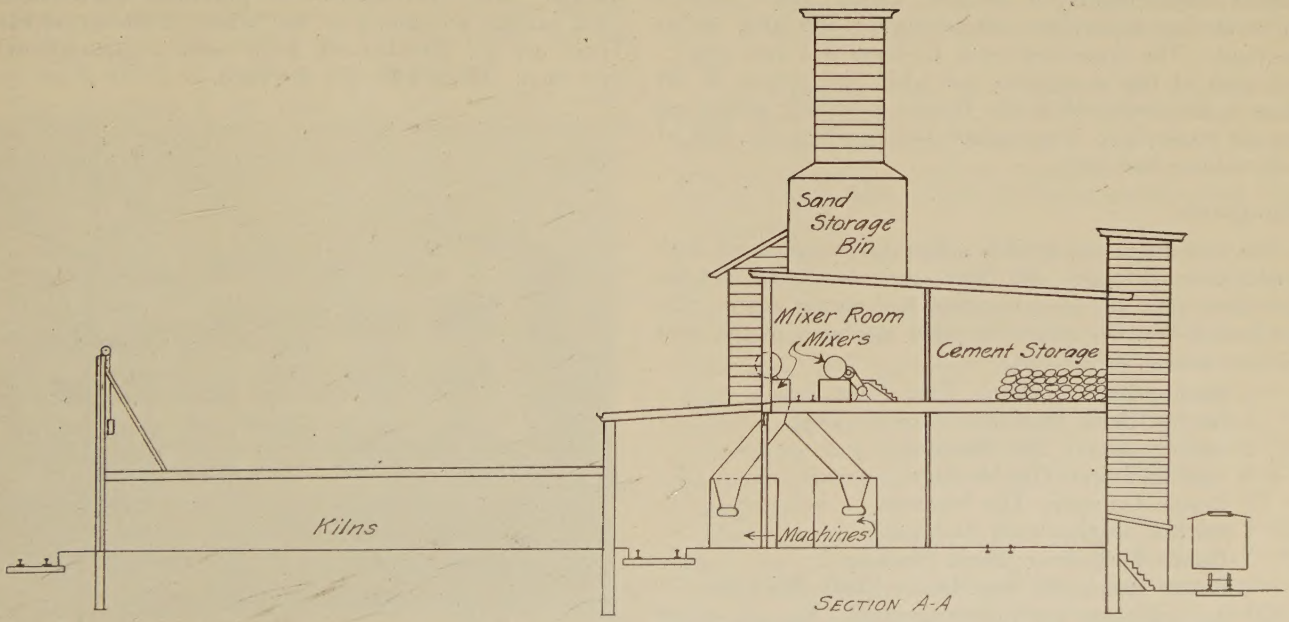
*A complete system of tracks, turntables and transfer tracks is installed to transport the products from the machines to the curing rooms and from the curing rooms to storage*

## Plant Layout

The design of the plant is the work of S. R. Edmonds, vice-president and general manager, who drew upon his twenty years' experience in the concrete products industry and who examined a great many of the more modern plants in the country before this one was laid out.

The design accommodates a logical flow of material through the plant so that in no case does raw material nor work in process double back upon itself. It moves through the various manufacturing operations swiftly and without loss of time nor extra handling.

Aggregates are brought from wharves by truck or unloaded at the plant from freight cars. Discharged into

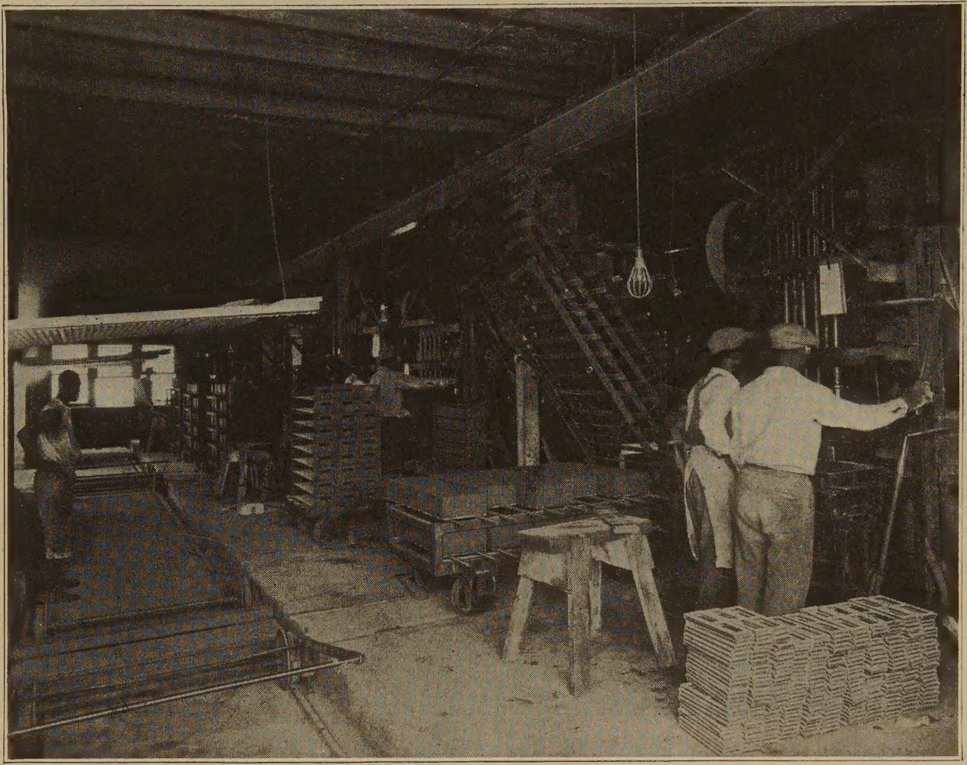


Cross section view of the plant

specially constructed hoppers, they are carried by bucket elevators to storage bins on the third floor of the plant and from these storage bins gravity brings them to measuring chutes over mixers on the second floor. Special aggregates are stored in bins near the mixers that handle them. Cement, received by freight car, is elevated to the second floor where there is ample storage capacity.

Two of the molding machines are fed direct from the mixers above and the others are served by dump cars running on a track on the second floor, these cars receiving their charges from the battery of mixers on the same level.

The installation of tracks in the plant and yard is elaborate and very efficient. The cast units, placed on rack cars, are run into steam kilns where they are cured 24 hours under low-pressure steam. The cars are run from the end of the kiln opposite the molding room onto a transfer track and thence are taken by tracks to the storage yard. Turntables are provided where needed. Each car has a capacity of 480 brick, 72 tile or 56 block. There are six double-track kilns with a capacity of 16 cars each. About 140 cars are used.



*Orderliness and cleanliness in the plant make for more efficient operation*

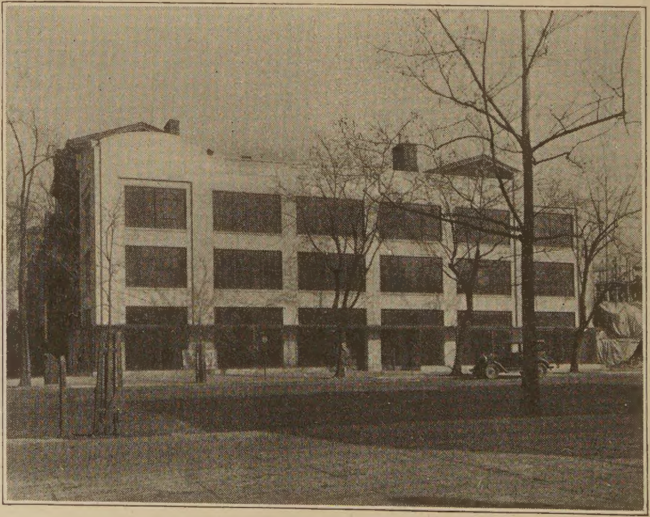
On the mixing level there are four mixers, two 21 ft. and two 7 ft. The second floor also houses the sack cleaning department and the pattern shops where complete woodworking equipment enables the plant to turn out special wood molds of various kinds. Here also is the modeling department where plaster and glue molds are made. The dimension stone business is a very important part of this enterprise and while the output of art stone is not included in the figures generally quoted on annual production, it accounted for 30,000 cubic feet of wall volume last year.

## Equipment

The manufacturing level is admirably adapted for high production operation. No floor space is wasted, yet the operating crew of each machine has ample room. The production load is carried by eight machines of the most modern design, as follows:

1 Anchor Brick Machine, Face-Down Type
1 Anchor Brick Machine—Face-Up Type
1 Anchor Junior Tile Machine
1 Anchor Power Tile Machine
1 Besser Automatic Tile Machine.
1 Anchor Single Power Stripper
1 Hobbs Face-Down Block Machine
1 Besser Automatic Face-Down Block Machine.

All the machines are power-operated. For all power purposes the plant uses seven electric motors varying from 10 to 20 h.p.



*Another example of the type of buildings in the construction of which Easco products are used*

The extensive storage yard has 45,000 square feet of storage capacity, threaded with the necessary tracks and with hard surface driveways. The company's delivery system is modern, from six to eight trucks being kept busy constantly. Each truck, with one exception, has a five-ton capacity.

The trimstone department has ample space for a molding floor in the main plant and here are made some of the most beautiful pieces of cast concrete stone offered on the eastern market. This product is popular with architects in Washington and surrounding cities and is found on some of the most important building jobs.

All of the company's products are marketed under the trade name "Easco," and this name is incorporated in a trade mark design used on all of the company's literature.

In war time the concrete industry's job in America was to increase productive capacity. Peak demand created a seller's market and in general over the country there was some decrease in quality. Since the war, definite advances have been made in manufacturing processes, resulting in quality improvement and cost reduction at the same time. The industry's next problem is selling methods—methods that will insure the disposition at profitable prices of the output of the productive capacity of the country's plants.

Easco products are frequently tested. The manufacturer shows laudable intent to maintain a high quality for his output and on all tests made, the products have exceeded by a comfortable margin the requirements of the standards set by the American Concrete Institute and the American Society for Testing Materials. Especially significant is the uniformity of the quality revealed by the tests. This constant and successful insistence upon uniformly high quality has done much to secure for Easco units the wide acceptance they enjoy in the Washington building market.

The Edmonds plant was carefully designed for the quantity production of a product of high quality and having achieved that goal, the company may safely be said to be out ahead of the average in the use of modern energetic selling methods. Newspaper space is used intelligently. A direct-mail campaign is kept going, literature being mailed regularly to architects, builders, prospective building owners and others who may be interested in permanent, artistic, low-cost construction. The company exhibits at local conventions, industrial exhibits, building shows, and uses artistic job signs on all construction work where its products are being used.

The personnel of the plant has been selected with a view to securing maximum manufacturing efficiency. The plant pay roll totals 40 to 50 men. The sales and executive staff totals eight.

The company was organized in January, 1926, the construction of the plant was started in March and completed in September of that year. The officers of the company are: president, E. S. Rowzee; vice-president and general manager, S. R. Edmonds; secretary-treasurer, R. B. Early. The board of directors is composed of the above officers together with several of the leading professional and business men of the city.

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## Announcing Concrete Products Sales Schools

Recognizing the need for more aggressive selling of concrete products, the Cement Products Bureau of the Portland Cement Association has inaugurated a complete merchandising schedule for products manufacturers. This merchandising plan will take the form of sales schools which will be held in concrete masonry centers throughout the country.

Manufacturers will be acquainted with the purpose of these schools and where they will be held, well in advance of the date on which they will be given. They will be urged to attend at least one of the meetings and to come prepared to discuss their various manufacturing and merchandising problems. A minimum of half a day and in some cases a full day will be required to allow sufficient opportunity to present the great amount of material that is to be covered.

While the program presented may appear to overstress plant problems, the discussion of quality and economical manufacture forms the basis for the merchandising section of these schools. Competition, such as there is today in all lines of industry where staple and necessary commodities such as building materials are fighting luxury materials for a larger share of the consumer's dollar, requires that the greatest amount of skill and force be used in merchandising products. If we fail to heed this warning we shall not be among the class of industries that will come through with flying colors in the age old battle of survival of the fittest.

In analyzing the need for aggressive personal selling, the following represent some of the vital questions which should be considered: Can a products manufacturer afford a salesman? How much shall this salesman be paid, and how shall he be paid? What should the salesman know and how should he be trained? These are but a few of the important problems that will be discussed in the session on selling.

Advertising will be discussed from the standpoint of salesman backup and considerable stress will be given to the various forms of newspaper and direct mail advertising. Charts will be used to bring out clearly and forcefully the leading points of the discussions.

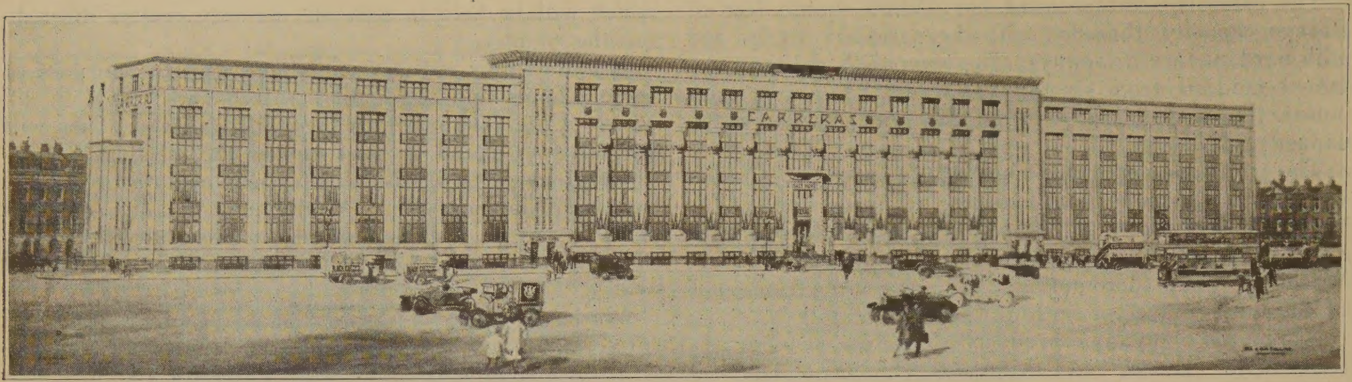
### First School Held at Minneapolis

This merchandising program of the Portland Cement Association was inaugurated in Minneapolis on Friday, March 30th, where the initial sales school was held. To give some indication of the favorable reception of this meeting on the part of the products manufacturers, the following is quoted from a letter written to the Portland Cement Association by W. W. Gibson, temporary secretary of the Concrete Products Manufacturers of Minnesota:

"Since you are about to embark on an extensive campaign covering the various problems confronting concrete products manufacturers, I thought you would be interested in the reaction received from those who were present Friday, March 30th, when you conducted the short course in Minneapolis.

"The boys were very enthusiastic about it, and it is the consensus of opinion here that it was the most masterly and thorough presentation of the entire subject that was ever given. It was carefully prepared. Technical questions and other problems that require special training were presented in such a simple manner that no one failed to grasp the points made and thoroughly comprehend the importance of it all. It was of intense interest and tremendous value to every concrete products manufacturer."

There is no doubt but that similar schools held in other concrete masonry centers will produce equally good results. The information and ideas that every manufacturer should secure at these meetings will be invaluable to him in solving his manufacturing and selling problems.



# London's Largest Reinforced Concrete Building Has Many Novel Features

There is now in course of construction in London a reinforced concrete building larger than any the British metropolis yet boasts. It is being erected in the northwestern portion of the city for Carreras, Ltd., cigarette manufacturing concern. The factory building will be exclusively of reinforced concrete, including the main chimney shaft. The architectural treatment is well adapted to the material.

An interesting feature of the structure is that colored concrete is being used and that three distinct types of cement are being employed, namely, rapid-hardening portland cement, ordinary portland cement, and aluminous cement.

The elevations are designed after an ancient Egyptian model treated conventionally to comply with modern requirements, and having as a central figure on the main frontage, columns 5 feet 3 inches in diameter and 47 feet in height, with a large and imposing ornamental cornice, all formed with colored concretes.

The design of the factory has been standardized and simplified as far as possible, and advantage has been taken of this feature to design the form work for repeated use. The total quantity of form work required is about 140,000 square yards, or 30 acres, most of it being in 1½-inch lumber. The area of external plastering will be about 24,000 square yards. The whole construction has to be completed in 18 months, and some 1,200 men of all trades are employed upon the job.

The building will have an artistic character all of its own, and although the architectural style is of ancient derivation it is thoroughly indicative of its modern use. The owners decided upon the construction of an ornamental factory building with the idea of brightening up a very drab neighborhood, fairly closely surrounded by slum districts. Very seldom has a reinforced concrete edifice with such comprehensive and detailed architectural treatment been attempted, and certainly never before in the United Kingdom.

The main elevation is about 550 feet long by 80 feet high above pavement level. The main external faces of the building are rendered with white portland cement and colored sand which gives a warm stone finish, the highly colored work being introduced as main features and points of interest. It is now well known that the greatest precautions are necessary if such rendering of color is to be without defect.

The Carreras building is in many ways a pioneer work, yet in no way is it being made the subject of speculative experiment. Numerous problems have, of course, inevitably arisen in such a novel departure as this structure represents. For example, the production of colored concretes that will be permanent and will stand the test both of time and London atmosphere, as also the insertion or attachment of the precast pieces (in some instances weighing upward of a ton) to the in situ concretes, are all problems that have now been successfully overcome.

The area of the total floor space available is approximately nine acres, or about 392,000 square feet. This huge area is secured on basement, ground, second, third, fourth and fifth floors. The roof is flat and upon it are erected water supply tanks, air conditioning rooms, etc. The roof is capable of being flooded during heat waves.

The floors have been divided into large panels, with the supporting beams spaced at 17 feet in the longitudinal direction and 18 feet transversely. Transverse walls separate the interior of the structure into three sections, known as north, south, and central. At each of these interior walls expansion joints are formed above the level of the ground floor in order to completely divide the three sections one from another. These joints were thought desirable owing to the length of the building and the rapidity with which the work is being erected. There are 260 internal columns. They are chiefly octagonal in section and are spirally reinforced.

The exposed surface of the interior work is being rubbed down with soft stone and cement grout as soon as practicable after removing the lumber shuttering. A smooth aseptic finish will thus be achieved. The official departments, including offices, board room and so forth, as also the health departments and housekeeper's residence, etc., will be plastered, tiled and decorated to harmonize with the Egyptian character of the exterior.

The work calls for approximately 24,000 cubic yards of reinforced concrete and 2,500 tons of steel rods. The weight of the aggregates required for concrete will amount to some 70,000 tons, and 7,500 tons of cement will be required. All these materials have to be handled in a period of about nine months.

In order to speed up construction rapid-hardening portland cement (ferrocrete) is being used for the floors.

Previous to commencing the construction of the main building a reinforced concrete retaining wall was built around the site. Aluminous cement was used for the concrete of this wall, and by its employment a very substantial saving in lumber work was erected, as well as the elimination of the usual asphalt lining.

Undoubtedly the most outstanding plant of the contract consists of the concreting towers. These are of the "Insley" type and are three in number. They are so arranged as to be able to deposit concrete at any point on the building. Each of them will be 160 feet high when depositing concrete at the level of the roof of the building, and they are taller than any hitherto used in constructional work in Great Britain. The concrete is mixed at the base of each tower in electrically-driven mixers, hoisted and delivered into a hopper, whence it flows in chutes to its required position.

# Faulty Foundation Was Cause of St. Francis Dam Failure

## Investigating Commissions Agree That Failure of Foundations Caused Collapse of St. Francis Dam Near Los Angeles—Extracts of Some of the Reports

According to the reports of three commissions that investigated the St. Francis dam failure, faulty foundations were given as the cause of the catastrophe. No criticism of the design, the construction or the materials used in the construction of the dam itself is to be found in any of the reports.

### Report of the Governor's Commission

Following are some of the extracts from the commission that was delegated by Governor Young to investigate the causes leading to the failure of the dam:

The concrete aggregate was pit-run sand and gravel from the stream bed one-quarter and one-half mile below the dam. Aggregate used in the construction of the aqueduct and the San Francisquito Creek Power Houses had been taken from the same source. The material was neither washed nor graded, but stone in excess of 6 inches was excluded. It is stated that 1.12 barrels of portland cement were used per cubic yard of concrete. Specimens deemed typical were taken and tested. These showed a satisfactory quality of concrete.

The dam was of the solid gravity type, curved on a radius of 500 feet to the upstream face at the crest. The crest thickness of the dam was 16 feet, and the maximum section was 205 feet high and 175 feet thick at the base. The batter of the upstream face changed from 1 in 27 to 1 in 10, and finally in the extreme bottom to 3½ in 10. The downstream face was carried up in a series of steps uniformly 5 feet high, and with widths varying from 5.5 feet near the bottom to 1.45 feet near the top.

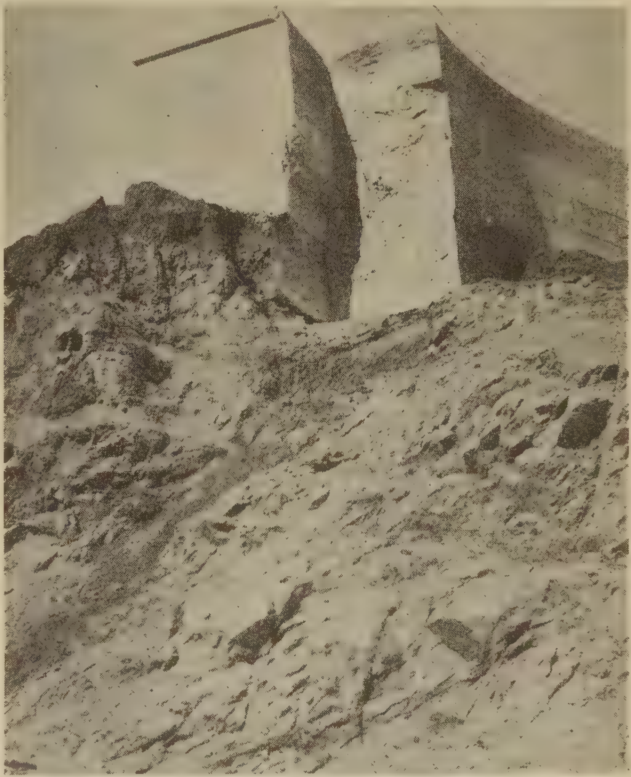
Both faces of the crest of the dam were vertical for 23 feet. The downstream face of this vertical section was divided into panels 24 feet wide, of which eleven panels in two groups were spillways. Each spillway panel was 20 feet wide by 1.5 feet high, clear inside dimensions. The five outlet pipes, each 30 inches in diameter, were controlled by sliding gates fastened to the upstream face of the dam.

Photographic evidence and the testimony of witnesses show that little seepage passed through the structure of the main dam. Certain cracks developed in the main structure, which possibly discharged an unimportant amount of water, as is not at all unusual in concrete dams. One or more cracks, with consequent unimportant seepage, also developed in the wing wall extension to the west of the main dam.

Much more important seepage is reported to have taken place through the foundation upon which the dam rested. As the water rose in the reservoir this foundation seepage appears to have increased to a maximum of between one and two second-feet on the afternoon preceding the failure. Rumors of muddy water seeping under or around the dam before its failure are in circulation, but the commission has been unable to verify them.

It is reported that one of the caretakers was seen on top of the dam at 11 P. M., only an hour before the failure. Apparently up to this time there had been no alarming developments. The caretakers were lost in the flood, and so far as is known there is no living witness of the dam's collapse.

The first indication of failure, given by the automatic water register located on top of the central or standing section of the dam, was a gradually accelerated falling of the water surface, starting about 11:30 (corrected time) and aggregating about three-tenths of a foot at about 12 P. M., when failure was indicated on the record by a rapid fall in the water surface.



*Character of foundation under right wing. In the upper section of the illustration is seen the right wing that broke away from the 613 ft. dyke*

At 11:58 P. M. there was a break in the Borel transmission line of the Southern California Edison Company which was located in the canyon immediately below the dam. At 12:03 A. M. the power from the Los Angeles City power plant No. 2 in the canyon about one and a half miles below the dam went off.

It appears that the failure of the dam took place at, or slightly before, 11:58 P. M., March 12, when the main dam structure, with the exception of a section near the middle, failed completely, leaving the greater part of the

*Nature of foundation of section of concrete dyke shown in the illustration on the page preceding*

left or easterly portion in very large fragments at and just below the dam site and great blocks of concrete up to about 10,000 tons in weight, chiefly from the right or westerly end, distributed for a distance of several thousand feet downstream.

*Erosion at base of 100 ft. center section which remained standing. Aggregate here was broken cleanly in two.*

The central section, which is still standing must have been exposed to tremendous and sudden stresses, while still subject to practically full water pressure. Yet it is undisturbed except for an apparent movement at the top some 5.5 inches downstream and 6 inches toward the easterly abutment.

No inspection gallery was carried through the dam, nor was any pressure grouting attempted under any part of the structure. The material in the dam is demonstrated by inspection, by tests, and finally by the behavior of enormous blocks remaining from the wreck, to have been of satisfactory quality and adequate strength. Tests of samples cut from typical blocks showed an average crushing strength of about 2400 pounds per square inch, which is much beyond any stresses to which it could have been subjected under normal conditions. There were no contraction joints built in the dam, which is the case in many existing dams. The failure cannot be attributed to their absence.

The conclusions of Governor Young's committee were summed up in the following three points:

(1) The failure of St. Francis dam was due to defective foundations.

(2) There is nothing in the failure of St. Francis dam to indicate that the accepted theory of gravity dam design is in error or that there is any question about the safety of concrete dams designed in accordance with that theory when built upon even ordinary sound bed rock. On the contrary, the action of the middle section which remains standing even under such adverse conditions is most convincing evidence of the stability of such structures when built upon firm and durable bed rock.

(3) The failure of this dam indicates the desirability of having all such structures erected and maintained under the supervision and control of state authorities. Water storage, with its necessary concomitant dams and enbankments, is peculiarly essential to the development of California resources, and in the great majority of cases failures would result in serious loss of life and property. This disaster emphasizes the fact that while the benefits accrue to the builders of such projects, the failures bring

*(Continued on page 46)*

# EDITORIAL

## Modern Cement Needs

FOR some time past there has been developing a demand for a new type of portland cement. It has not come suddenly, but is the inevitable outcome of a number of contributing developments that tended in that direction.

The exact nature of this new demand was plainly illustrated in a conversation the other day with a contractor whose work is national in scope. "If I could find a cement that would enable me to strip my forms in two or even three days, I would be willing to pay a substantial premium for it," he said. "Just think of what it would mean to me," he continued, "Form work costs from eight to ten and more dollars per cubic yard of concrete placed. Most jobs are so designed that the same forms with very little change can be used on the various floors or sections of the building. Now, if I could strip these forms in three days instead of in ten or fourteen days, I could cut my form costs a fourth. Sure, I'd be willing to pay a lot more for such a cement because I'd be ahead on the deal anyway. Besides, I could organize my gangs better."

Here was a man who was consistently following the modern trend of reducing costs and improving the efficiency of his production organization, and he wanted to do this in the most practical and direct way,—that is, by using a cement that would meet the requirements under ordinary methods of placing. Either he did not know that special cements are now being made, or he knew that they are and realized that they are not equally available in the various sections of the country where his jobs are located.

He referred to this second problem thus: "Where can I get these special cements, and how can I know that the cements I buy will meet these conditions? I may have a job in Buffalo and another in Florida and another in Minneapolis. Can I get the same type of cement in each of these places? Lots of cement salesmen tell me lots of things about their cements, but how can I, or the engineers or architects on my jobs, make sure of similar results in widely separated places when I have no means of measuring these special qualities?"

These are vital questions for the contractor and he is expecting the answer. Recently there have been definite indications that some cement manufacturers are frankly setting out to meet this demand for a special cement widely available. New folders are continually announcing portland cements that are especially designed to meet this need.

With at least one of these cements now available on a practically national scale, concretors may, with the payment of a higher price, secure cements that will give them high early strengths under ordinary methods of mixing and placing.

That answers one of the questions of our contractor friend, but it does not answer them all. He must still take the word of cement salesmen for the fact that these cements will develop the strengths he is seeking. After he has had experience with a certain brand, he may buy additional cement of the same brand with confidence, but still he has no standard measurement or specification by means of which he may know that he is securing the same qualities on all his various jobs.

Is it not probable that the time is well nigh here when more than one "standard specification" will be necessary: to enable the contractor to keep in step with cost reduction; the manufacturer to serve a logical economic demand; and the industry to continue forward in its competition with other industries?

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## This Modern Style, if Any

UNDER the above title, Walter Dorwin Teague writes in a recent issue of "Advertising and Selling," about what he considers the development of a new style. This new style, if it is really a new style, must be evident in all the arts and crafts, and Mr. Teague goes on to show that it is.

What has that to do with concrete? Much. Read what he says about architecture, then read Mr. Hart's paper delivered before the Concrete Reinforcing Steel Institute meeting recently and published on another page and see if you can detect any similarity.

Here are some portions of Mr. Teague's article: "Look at the General Motors Building at Broadway and Fifty-seventh Street especially at noon on a sunny day. Or at a dozen other skyscrapers, or at the city itself from a high building. * * * Modern life is ruled by geometry, our eyes are accustomed to it at every turn, and it is in geometrical forms that the aesthetic spirit of today finds its satisfaction. * * * Good architects are designing their buildings in the same spirit of insistence on line and proportion, depending for their effect on the interplay of planes and solids. * * * See how all these characteristics add up to make an impressive total: a love of hard and bare simplicity coupled with an extreme sensitiveness to fine line and proportion, a hatred of pretense and pretentiousness, an equal repugnance to the hackneyed and tiresome."

# Heavy Duty Concrete Floors

## Some Practical Suggestions for Placing Heavy Duty Concrete Floors—Methods That Will Prevent Dusting and Undue Wear—Methods Recommended Are Result of Long Experience and Careful Study

By C. E. COVELL*
Eastern Construction Manager, The Austin Co., Philadelphia

THE subject discussed in the ensuing paragraphs represents one of the most troublesome of the many minor problems which fall to the lot of building contractors. Briefly stated this problem involves the construction of concrete floor surfaces which will not dust or show an undue amount of wear over a reasonable term of years under the severe and sometimes exceedingly destructive service incident to modern industrial occupancy.

### What Is a Good Concrete Floor?

A good concrete floor for ordinary industrial use must embody two essential characteristics: First, strength to resist compression and shear in the slab due to static loads of machinery and stored materials and to the concentrated wheel loads of moving trucks; and, second, resistance to surface wear and dusting due to impact and the abrasion and crushing of the surface particles caused by truck wheels, the shoes of the workmen and loads dragged over the surface.

The first of these requirements is easily attained by using a proper slab thickness, adequate reinforcement and care in producing a uniform concrete of predetermined strength. The second, however, is far more difficult to secure even when extreme care is exercised. This is especially true in industrial building where the processes require the use of steel wheel trucks which not only tend to crush the surface but also to cut and gouge as the trucks are turned.

It may be conceded that under ideal conditions of temperature and humidity and where exceptionally good aggregates are readily available, special processes of surface finish and even standard methods can result in concrete floor surfacings which will compare favorably with any known substance ordinarily used as flooring materials. The real problem, however, is to produce invariably good results with materials found within easy hauling distance of the job and at a price little, if any greater, than the cost of the usual methods of finishing. In spite of the fact that floors are the only part of the structure which take heavy and continuous wear and that they are difficult to repair without interruption of the operations of the plant, most owners hesitate to spend extra money for finishing processes which will provide additional durability.

Concrete is a singularly attractive medium for finished floor construction because of its inherent possibilities of economy in first and ultimate cost, fire-safeness, high resistance to all ordinary industrial processes and a degree of sanitation not possible in more absorbent substances. It is the only flooring material which can simultaneously combine the functions of a wearing surface and a load-carrying integral part of the structure itself. Its use in increasing millions of square feet annually of floors attests its present popularity. Yet all of these advantages, and even its continued use may be jeopardized unless some economical methods can be devised to overcome its one fault, namely, this all too frequent tendency to dusting which often starts soon after the floors are placed in service and which indicates a more or less serious lack of resistance to wear.

In a construction experience which extends back over a term of more than fifty years, the company which the author of this paper represents has laid a hundred million of square feet of concrete floor surfacings, largely in buildings of an industrial type. At first these floors were built of foreign-made cements but within the past twenty-five years the advent of high quality American-made portland cement has resulted in its substitution for the foreign-made product. Observation indicates, however, that the origin of the cement does not play a material part in the problem.

Naturally an experience of fifty years' duration has resulted in a certain amount of improvement in the initial processes and methods of building floor surfacings but it is a curious fact that in spite of all that has been observed and learned as to the behavior of concrete floor surfacings the early problems of dusting and excessive localized wear are as fresh today as ever. Even under the best recommended practice of building this type of surface, the degree of uncertainty is still very great. In fact, our experience over the past five years seems to indicate that it is virtually impossible to obtain a surface of uniform freedom from dusting and resistance to wear under the usual practices of laying whether the surface be a monolithic finish or one using a separate top course of similar composition. Our experience in this regard seems to be similar to that of others with whom we have discussed this problem.

### First Experiments

In 1923 we undertook a rather extensive survey of the whole question of concrete floor surfacings with the result that the following facts were developed:

1. The cost of concrete floors in our standard buildings averaged 15 per cent of the total cost of the structures.

2. Placing these floors in the ordinary accepted fashion resulted in a considerable expense annually for repairs and replacements.

3. Floor repairs and replacements could offset the profits on any job and in some cases exceed them.

Such a condition certainly demanded immediate and definite action. As a first step, we got in touch with the Portland Cement Association and outlined the situation. We received their whole-hearted co-operation. After considerable study with them, we published a bulletin on concrete floors for the use of our superintendents which reviewed the results of our past experience and gave definite instructions on the methods of handling certain features of concrete floor work. The features which received special stress were:

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1. That no concrete should be poured using a wet and sloppy mix but that it should have such a consistency that screeding and floating would be required to bring water to the surface.

2. That concrete must be mixed for not less than 1¼ minutes and longer, if possible, up to 2 minutes, calling attention to the fact that concrete mixed for 2 minutes was about 35 per cent stronger than when mixed for ½ minute.

3. That properly graded aggregates were very necessary and that aggregates for floor work must be strictly in accordance with our specifications.

4. That proportions specified must be followed strictly and that no attempt be made to save cement.

5. That it was very important to test the fine aggregate for organic impurities in accordance with instructions given.

6. That only trained, qualified men were to do the floor finishing and that superintendents were not to use, as had been a common practice in the past, anyone available at the time who was doing nothing else in particular.

7. That floors were to be troweled as little as possible commensurate with a smooth surface.

8. That absolutely no "drier" was to be used in surface finishing.

9. That floors should be properly cured for a period of at least 10 days, or longer, if possible. Data of the Portland Cement Association were furnished and attention directed to the fact that proper curing increases the strength and resistance to wear very materially.

We soon registered a marked improvement in the quality of our work, but even after this determined effort to secure better floors, we found we had to go still further to get the desired results if we were to continue to use concrete floors under rather severe trucking conditions.

## Sand Tests

With this in view, we made tests on many different sands available for concrete work all over our eastern district and found in every case enough very fine soluble or insoluble matter to authorize the statement that there is no commercial concrete sand available in the East that we would say is 100 per cent suitable for the wearing surface of concrete floors which are to be monolithically finished by screeding, wood float, and, finally, with a steel trowel.

In examining these sands, we used test boxes 2 feet square and 4 inches or 5 inches in depth which were filled, screeded, floated, and troweled in the usual floor-finishing manner. In almost every case, the very fine matter contained in the sand was brought to the top or wearing surface of the slab by this ordinary process of finishing. On several test blocks ⅛ inch of very fine material was deposited in the bottom of the box before the coarse aggregate was put in, this fine material being removed from a larger amount of the coarse aggregate by screening. It was found that the suction developed by the floating and steel trowel finishing was sufficient to bring a large percentage of the fine material up to the top of the slab, especially if an excessive amount of water was used in mixing.

Further (even when this excess amount of water was very slight), we found that it had the effect when brought to the top by screening and floating of carrying off the cement in the very top of the slab after the darbying process, leaving the wearing surface virtually devoid of cement. Then, when the cement drier was applied in accordance with the usual practice, to take care of the remaining water on top of the slab, or to get the slab in a workable condition, there was formed what appeared to be a very hard surface under the steel trowel but which in reality was composed of only the drier on top and directly beneath the fine material which, as before described, had been brought to the top of the slab. These tests but confirmed our observation of the causes of failure of some actual floors.

These tests also proved that under no circumstances can a drier be safely used on a concrete floor later than one-half hour after the concrete has been deposited in place. We all know that it is a common practice of cement finishers to use a cement drier sprinkled over the top of the slab to absorb excess water as late as one to three hours after the mixing and placing of the concrete. Our tests proved conclusively that it is absolutely impossible to get a hard wearing surface when this practice is followed.

## Sand Test Conclusions

With the idea in mind that it was entirely reasonable and possible to improve the quality of concrete industrial floors at no increase in cost and having made these tests and observations, we came to the only natural conclusion, i. e., that it is simply a choice of two methods:

1. To secure a sand that is absolutely free of loam organic impurities, or the fine material. Our investigation of sands showed that it is possible to get a good material at three or four different points in the eastern district which would serve our entire territory in the East but that the cost would be prohibitive as there would be required the installation of special washing machinery and screens to take out the fine material and that the sand would have to go through a triple washing operation in order to be sure that all the fine material was removed. This increased cost of the sand would add from three to five cents a square foot to the cost of the finished floor depending on the location of the work.

2. To use a sand which meets the specifications for concrete sand for other types of work, if, after the floor was finished, we could remove the skin of poor material on the surface by grinding. We decided to give this second method a trial and first used it on an industrial plant in Virginia.

In this case we had a monolithic floor laid directly on grade. The floor was 5 in. thick and unreinforced except at machinery pits. The concrete mix was 1:2:3½ using local sand which contained a large percentage of material too fine for the purpose and a crushed limestone ranging in size from ¼ to 1½ in. This stone contained small particles of shale or clay material. No attempt was made to place any type of topping. The concrete merely being mixed quite dry, placed in position and struck off with a straight edge, a tamper, and a long-handled darby to a fairly level surface. The floor was cured under wet sawdust. The grinding was started when the floor had cured for 5 days.

The finishing process was carried on by the use of three hand-operated electrical grinding machines and sand as an abrasive material was used under the cutting heads of carborundum to assist in producing a smooth surface. Plenty of water, however, was used during the grinding operation. No attempt was made to produce a true and even-textured surface, the desire being merely to remove all dirt, laitance, and float marks left by the straight edge and darby. This resulted in a floor which showed areas resembling a fairly good trowel job and other areas where the aggregate was exposed. There was a small amount of pitting due, in all probability, to the clay content of the aggregate and possibly to accumulation of fine sand in pockets which were picked up under the grinding.

Accurate costs were kept on the work and it was found that this method of finishing was costing only slightly more than one cent a square foot, including labor, machinery rental, supplies, and power. The cost of the rough base was also quite low because little if any overtime was required in producing a surface smooth enough for grinding. From this first job and several succeeding ones where the floors were laid in about the same manner, and totaling about 1,000,000 sq. ft., we learned a number of important facts, viz.:

1. At least ten days must be allowed to water cure the floor before grinding it.
2. Coarse aggregate containing any considerable amount of flat elongated particles or of soft particles will cause pitting of the surface when the floor is ground.
3. The top surface of the concrete floor must be of a richer mix than that obtained by the use of a 1:2:3½ or 1:2:4 concrete.
4. The use of a smaller maximum size of aggregate in the top will give the finished floor a more uniform appearance.

### Results from Revised Specifications

We then revised our specifications to incorporate these changes and the floor of the building for the Wildman Manufacturing Company at Norristown, Pa., was laid with a base course 4 in. thick of 1:3:5 concrete, placed with 2 in. slump. This base was leveled off and immediately a 1:1:1 top coat, consisting of cement, concrete sand, and pea gravel was applied to a thickness of 1 in. This top coat was placed with a 2 in. slump. This topping was leveled off with straight edge and finished with a wood float and a single application of a steel trowel. The surface was then covered with wood shavings and kept wet for 10 days. At the end of this curing period, grinding was started, it being done from 10 days to 3 weeks after the placing of the concrete. This floor turned out to be in appearance and apparent hardness, vastly superior to any floor we have ever laid, the surface being smooth, hard, close-grained with apparently no dusting. Average costs for all of the floors finished in this manner to date, approximately 1,200,000 sq. ft., are under 3½ cents per sq. ft. which includes cement finishers' labor for straightening, floating and finishing and all expense of grinding, viz.: grinding machine rental power, grinding discs, etc.

### Wear Tests

Floors using a separate 1:2 topcoat were placed so recently that naturally we did not have any information as to its resistance to actual severe trucking and other abuses of factory operations over a period of years, but to obtain an idea of its wearing quality a trucking or abrasion test was conducted about a month and a half after the floor was completed. The apparatus consisted of a heavy table about 30 in. high supporting a motor and reducing pulleys and shafting to give a slow turning motion to a vertical shaft placed near the end of a heavy timber extending from one corner of the table. This shaft near its upper end ran in a box fastened to the side of the timber and its lower end was held in place in a foot-block fastened to the floor. Near the bottom of the shaft was keyed a horizontal plate from which extended, 90 deg. apart, four arms fastened loosely to the plate so that they were free to move up and down slightly. Underneath the outer end of each arm was fastened a steel truck wheel. These wheels were 2¼ in. wide and 6 in. in diameter and the wearing face was slightly convex. The wheels were spaced so that in turning they described circles of 48, 44, 40, and 36 in. in diameter. Therefore, no two ran in the same groove. On the arm over each wheel was placed a weight of 100 lb. This would equal a live-load of 300 lb. on the common three-wheel factory truck wheel which is probably more than the average actual load.

The apparatus was geared to give the wheels a speed of 15 r.p.m. The test was continued for four consecutive days and ran for a total of 26 hours. The first appearance of dust was noticed 3 hours after the test started and gradually accumulated as the test continued. Upon the completion of the test four distinct grooves were worn in the floor varying in depth from 1/64 to 1/32 in. below the original surface. While the surface of these grooves was generally somewhat rough there was no apparent tearing up of the concrete. The wear was fairly gradual and regular over the whole surface.

What period of time this test would represent under actual conditions is, of course, indeterminate, there being such a wide variation in trucking conditions in different factories and industries. But let us assume that under the average actual condition a truck wheel would run over a given spot once an hour. Then, neglecting the constant turning action of the wheels in the test, one hour of the test would represent 900 hours of actual service. The period of the test would represent 26 x 900 or 23,400 hours of service. Using 55 hours as the factory week, it would be equivalent to about 8¼ years of service. It is believed that this imposed a much more severe wear to the floor than would be experienced under actual conditions for most of actual trucking is done in fairly straight lines with only occasional turning while in the test the turning and gouging action of the wheels was constantly present.

In any devised test of short duration it would probably be difficult if not impossible to simulate actual conditions and the test described we purposely made severe in order to get in a short time some idea of what the floor would stand. We feel that the floor tested is as good as it looks and that it will withstand severe trucking for a great many years without appreciable wear and that the dusting caused by wear will be so slight as to cause no concern. In the Eastern district we have placed and ground about 200,000 sq. ft. of floor similar to that at Norristown and each unit apparently is as good as the one tested.

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## Minnesota Products Makers Hold State Convention

The state convention of Minnesota concrete products manufacturers took place on March 29th and 30th, at the West Hotel. Talks on subjects such as reasons for a state building code and lower insurance rates occupied the first day.

The second day was devoted entirely to a short course on efficient plant operation, business administration, merchandising and salesmanship, arranged by the Portland Cement Association.

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## Welsh Bridge Built on Rolling Lift Principle Opens

A bridge newly completed across the River Dee, Wales, has two piers each consisting of two cylinders sunk into the river bed, while the abutments are of mass concrete built on reinforced concrete piles. The girders of the opening span are of the Warren type from 17 feet to 30 feet in depth. Each leaf has two quadrants which roll along track girders on the fixed span for 26 feet. The weight of each moving part is about 330 tons.

# Speedy Concrete Floor Construction in Winter

## Floors in 28-Story Apartment Building Placed at Rate of Five Stories a Week—Standardized Forms Used—Roofing Gravel Used as Coarse Aggregate

THE 28-story steel-framed and concrete-encased apartment building known as the East End Avenue Apartments, at the corner of East Fiftieth Street and East End Avenue, in Chicago, has provided a good example within the present winter season of the wisdom of continuing concrete construction in winter.

In the months of January and February, 1928, during which sub-zero temperatures were reached several times, the reinforced concrete floors in this building were placed at the rate of five stories a week. The building is an L-shaped structure with a frontage of 140 feet on East End Avenue and 107 feet on East Fiftieth Street. The part along East End Avenue is 49 feet 6 inches wide, and the one along East Fiftieth Street is 10 feet less. Consequently the floor area of the building is about 9,200 sq. ft. The quantity of concrete in each floor averages about 150 cubic yards, indicating that an average daily rate of about 125 cubic yards was maintained.

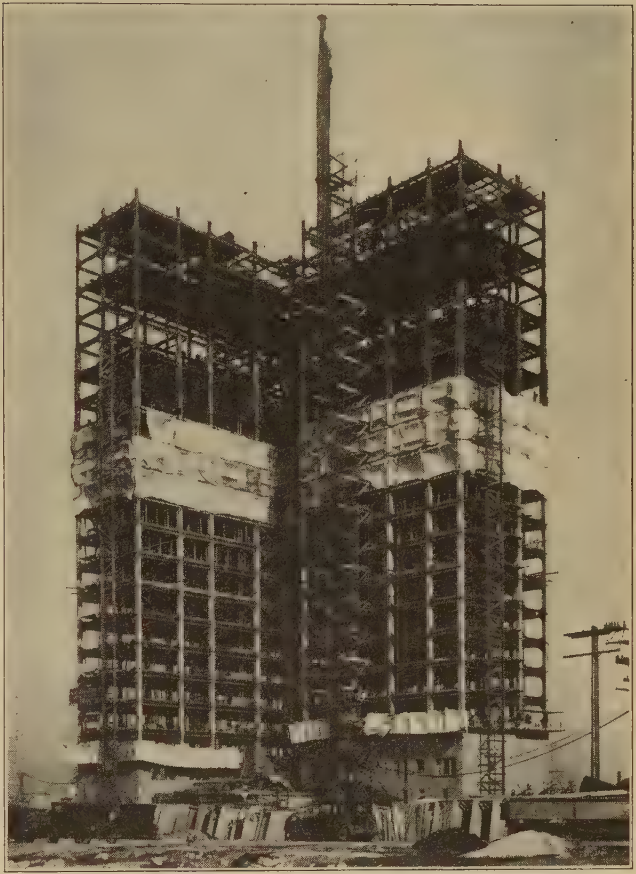
The speed of concreting on this building, considering the size and shape of the structure and the area over which operations were conducted, would be creditable enough in the summer season. The rate of progress compared favorably with the speed attained on the Barlum Tower, a 40-story office building in Detroit, reported in the February issue of CONCRETE, page 40. The two buildings are almost identical in floor area but differ in shape.

### Standardized Forms Used

A construction feature that helped the progress on the East End Avenue Apartments consisted in the use of standardized wooden box forms such as those described in detail in an article entitled "Reducing Construction Costs by Using Standardized Wooden Forms," in the October (1927) issue of this magazine. The labor involved in the erection of these forms is much less than where forms are built in the ordinary way, and their rigidity permits carpenter crews to work on a newly-placed floor 24 hours after the concrete is deposited.

The protection against cold weather provided on this project consisted of tarpaulins. The interior was heated by coke-burning salamanders, about 75 on each floor. An interior temperature of about 60 to 75 degrees was maintained during mild weather, but during extremely cold weather the temperature was held at 75 to 85 degrees. The concrete itself had a temperature of about 55 degrees when placed. It was protected for 72 hours. No cylinder compression tests were made at the end of this 72-hour period, but the 24-hour tests indicated an average strength of about 300 pounds a square inch and the 7-day tests gave quite uniform results averaging just above 1,200 pounds a square inch.

The floor construction consists of rectangular joists spaced 3 feet on centers, acting as T-beams with a 2-inch slab. The concrete joists are 12 inches deep, measured from the top of the slab, and 5½ inches wide. The floor panels measure 16 by 21 feet in plan. During the hardening period each floor panel was supported by a line of shoring timbers in one direction along the center line of the panel. The shoring timbers were 4 by 4 inches in size and were spaced 3 feet apart, one shore having been placed under each joist. A wooden bridging joist extending the full length of the panel was in immediate contact with the concrete joist. The shoring timbers were carefully placed so as to get each one immediately above the corresponding one in the story below.



*The East End Avenue Apartments, Chicago, in which reinforced concrete floors were placed at the rate of 5 stories a week*

### Roofing Gravel Used as Aggregate

An interesting feature of this work was the use of roofing as the coarse aggregate. According to C. T. Montague, superintendent of construction for the Avery Brundage Company, who had the contract for the masonry and reinforced concrete work, this roofing gravel, ranging in size from ¼ to ⅜ of an inch, had a smaller percentage of voids than that of the larger gravel first used on the work. The size of the larger material ranged from ¼ to 1½ inches. Tests made by the Robert W. Hunt Company, of Chicago, indicated about 42 per cent of voids in the roofing gravel and about 45 per cent in the larger gravel.

As a direct result of the smaller percentage of voids in the roofing gravel the yield was greater. Tests indicated, Mr. Montague said, that the production of one cubic yard of concrete required 41.3 cubic feet of separate volumes of sand and roofing gravel. With the larger gravel as the coarse aggregate the production of one cubic yard of concrete required 43.2 cubic feet of the separate volumes of sand and gravel.

Ordinarily one would expect gravel graded from a small size to a large size to show a smaller percentage of voids and a greater yield than could be obtained with small gravel. The lower percentage of voids in the roofing gravel disclosed by the tests and experiments in this instance probably was due to the more careful grading of gravel prepared for the special needs of the roofing material market. Roofing gravel may also be expected to be of high quality. While it costs more than ordinary gravel intended for structural concrete, its greater yield in part offsets the difference in cost.

The general contractors on the East End Avenue Apartments are Fridstein & Company, 111 W. Washington St., Chicago. The masonry and reinforced concrete work was built by the Avery Brundage Company, 110 S. Dearborn St., Chicago. The architects were Robert S. DeGolyer & Co., 307 N. Michigan Ave., Chicago, and the structural engineers were Smith & Brown, also at 307 N. Michigan Ave.

## D. A. Garber New Manager of Contractors Group

D. A. Garber, New York builder and construction expert, on May 1st becomes general manager of the Associated General Contractors of America. He is the successor of Gen. R. C. Marshall, Jr., Washington, D. C., who is resigning his position to become president of the Chicago firm of contractors, Sumner Sollitt and Company.

In order to make the change, Mr. Garber is terminating his connection with the North-Eastern Construction Company, New York, which he joined in 1904.

General Marshall has held the position as general manager of the organization for eight years and was wartime chief of army construction.

## American Road Builders Appoint Chief Engineer

The American Road Builders' Association announces that C. N. Conner, of the Highway Research Board, has been retained as chief engineer of the association.

Mr. Conner's work for the present will consist of coordinating the activities of the committees of the several divisions and arranging for the committee reports which will constitute the program of the next convention. The County Highway Officials' Division, the Highway Contractors' Division and the City Officials' Division will operate through committees and their reports form the basis of the program for the next convention.

## Reinforcing Steel Chain Embedded in Concrete

Concrete will embed the chain of stainless steel to be used in strengthening the dome of St. Paul's Cathedral, London, England. The chain, weighing 30 tons, will have links 3⅜ inches wide and about 15 feet 4 inches long. Its total length will be 450 feet.

# *New Books*

## A Convenient Handbook

CONCRETE PRACTICE. A textbook for vocational and trade schools, by George A. Hool and Harry E. Pulver. Published by the McGraw-Hill Book Company, New York.

This book, although announced on the title page as a school text, is one which many contractors will find a convenient handbook of standard information regarding concrete work.

The book is up to date in all important respects and in line with the best current practice. Although arranged in conventional textbook form, the material is so tabulated and sub-headed as to be easily available. Not many contractors will care to work out the formal problems which are stated for class use, but the information which goes along with these problems as essential to their solution is just the sort of material that any man working in concrete can use.

Among the various appendices at the back of the book is to be found a table showing the effect of various liquids on concrete, and the preventive treatment advisable when concrete is to be subject to contact with any of the liquids mentioned. This table in itself is no new thing, but is very convenient to have available when doing work which may be exposed to acids, oils, etc.

## Reinforced Concrete Construction

RETAINING WALLS AND BUILDINGS, second edition of Volume 2, by George A. Hoole, S. B. Published by the McGraw-Hill Book Co., Inc.

The appearance of this new edition of the second volume of Hoole's "Reinforced Concrete Construction" brings the entire three-volume work up to date. In view of the position occupied by this work the revision of this volume is sure to be received with appreciation by most of the people in the concrete construction industry.

The revision of this book has been quite thorough, and adequate consideration is given to nearly all new methods which have been developed in the past few years. Both design and construction are discussed quite fully, and there is an excellent section on estimating which even experienced contractors will find valuable.

## A Practical Design Manual

PRACTICAL STRUCTURAL DESIGN IN TIMBER, STEEL AND CONCRETE, by Ernest McCullough. Third edition revised and enlarged. Published by the Scientific Book Corporation, New York.

This book provides a general guide to all the common problems of structural design without going into elaborate detail on any of them. It discusses the mechanics of material and the mechanics of structures and structural design with a minimum of intricate mathematics.

## A. S. T. M. Tentative Standards

1927 A. S. T. M. TENTATIVE STANDARDS. Published by the American Society for Testing Materials, Philadelphia.

As usual, a fair portion of the space in this book is given over to tentative specifications for concrete or the materials of which concrete is made. There are several interesting tests of aggregates which are worth careful study on the part of the construction industry generally.

# Reinforced Concrete Design Simplified

## Chart B—Dead-Load Beam Information

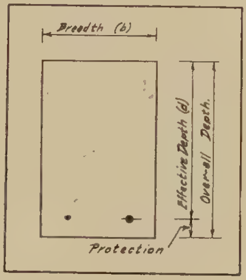
By PROF. JAMES R. GRIFFITH
Armour Institute of Technology; Assoc. M., A. S. C. E.

### *Joint Committee Specifications*

$f'_c =$ 2,000 lbs. per sq. in.
$f_c =$ 800 lbs. per sq. in.
$f_s =$ 18,000 lbs. per sq. in.
$n =$ 15 lbs. per sq. in.

$M = Kbd^2$
$A_s = pbd$
$K = 138.7$
$p = 0.0089$

Dead-Load Weight = 150 lbs. per cu. ft.



DEAD-LOAD information is always a troublesome factor in the design of reinforced concrete members, especially for the inexperienced or occasional designer. Chart A has one scale giving approximate unit dead-loads, which must not only be checked but turned into its equivalent in bending moment. Chart B has been designed to supplement this approximate information and further reduce design labor.

### Chart B Application

Chart B is composed of two distinct nomographs giving the following information:

(1) Breadth of beam
Overall depth of beam
Unit dead-load weight

(2) Unit dead-load weight
Span
Total weight of beam
Dead-load bending moment

Two separate isopleths are necessary for complete solution with two variables in each group determining the alinement. The scale giving Unit Dead-Load Weight is common to both nomographs.

In order to give the reader further practice in the use of Chart A, an entirely new problem will be discussed.

*Required:* To design a beam, reinforced for tension, for a simple span of 25 feet with a live-load of 1000 pounds per linear foot. Limiting values being $f_c = 800$ lbs. per sq. in., $f_s = 18{,}000$ lbs. per sq. in., and $n = 15$.

While Chart A is for definite limits of stress, Chart B is applicable to any conditions. Chart B is designed primarily for dead-load information but can also be used for finding live-load bending moments. If the unit dead-load scale is used for live-loads, the dead-load bending moment scale will give the live-load bending moments. An isopleth, or straight line through the L. L. = 1000 lbs. per ft. and the span of 25 feet, dotted line (1) Chart B, will give:

L. L. Bending Moment = 940,000 inch pounds.

Referring to Chart A with this live-load bending moment, a desirable combination is found with the breadth (b) of 16 inches giving an approximate dead-load of 395 lbs. per lin. ft. Increasing this value as explained under Chart A:

Approx. D. L. for L. L. moment = 395 lbs. per lin. ft.
Estimated increase 25 per cent = 99 lbs. per lin. ft.

Probable total dead-load = 494 lbs. per lin. ft.

Chart B, dotted line (2), for this dead-load and the span of 25 feet gives:

D. L. bending moment = 460,000 in. lbs.

The total bending moment can now be determined:

L. L. bending moment........ 940,000 in. lbs.
D. L. bending moment........ 460,000 in. lbs.

Total bending moment........1,400,000 in. lbs.

Again referring to Chart A with this total bending moment of 1,400,000 in. lbs., the following conditions give a satisfactory solution:

Bending moment = 1,400,000 in. lbs.
Breadth (b) = 16 inches
Effective depth (d) = 25.2 inches
Approximate D. L. = 485 lbs. per ft.

Reducing this effective depth to $d = 25$ inches, and adding 2 inches of protection, the overall depth will then be:

Effective depth = 25 inches
Protection = 2 inches

Overall depth = 27 inches

Referring now to Chart B, an isopleth, solid line (3), through the breadth of 16 inches and the overall depth of 27 inches gives a dead-load of:

Unit dead-load = 455 lbs. per ft.

An isopleth, solid line (4), through this dead-load and the

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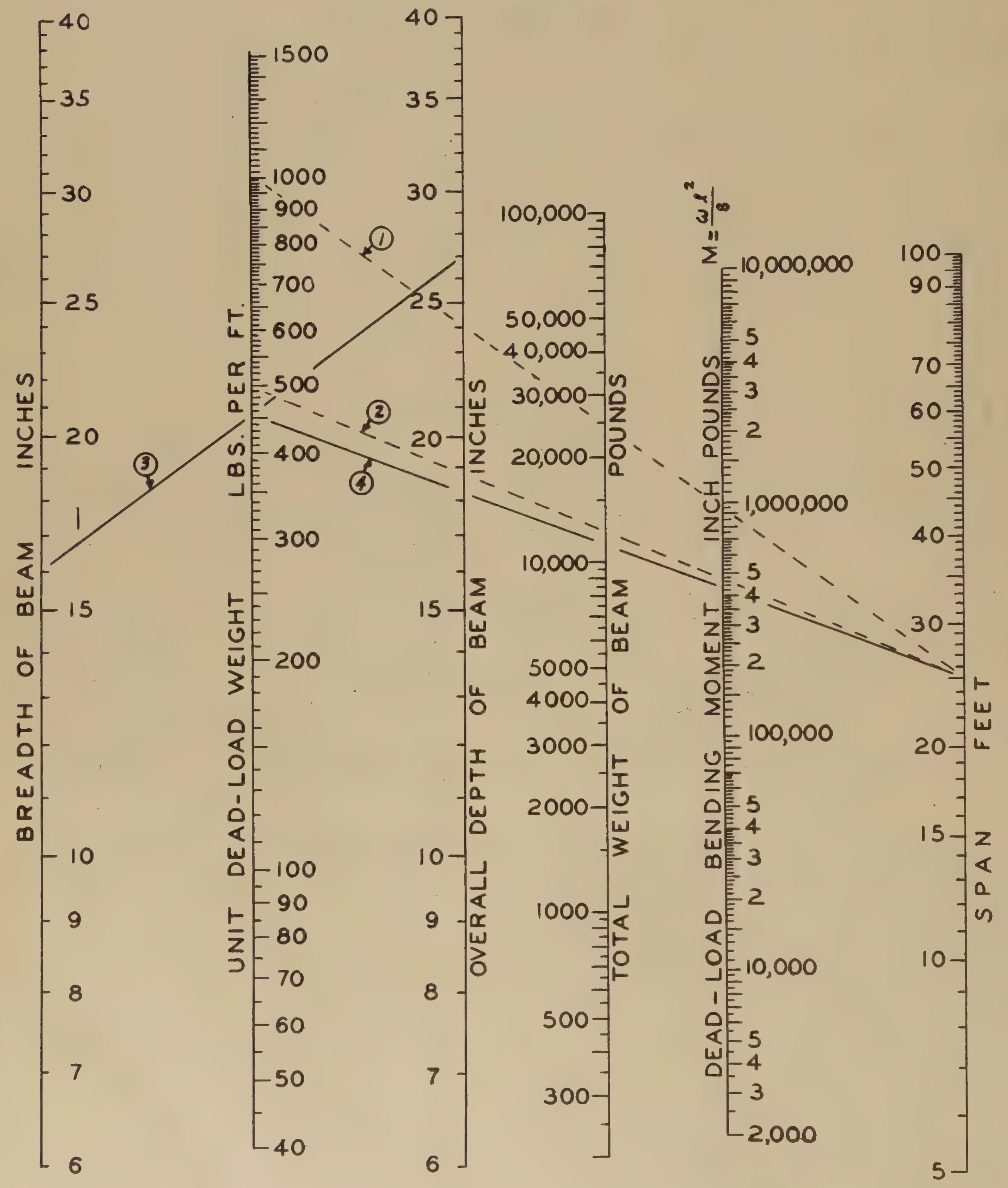
Editor's Note: Charts are lettered consecutively. Equations and figures are numbered consecutively for each issue but also have chart letter with which they will be found. Those found in the introduction have no letter.

## CHART B

### *Dead-Load Beam Information*

Dead-Load Weight = 150 lbs. per cu. ft.



span of 25 feet gives:

D. L. bending moment = 430,000 in. lbs.

The total bending moment is then:

| | |
|---|---|
| L. L. bending moment | 940,000 in. lbs. |
| D. L. bending moment | 430,000 in. lbs. |
| Total moment | 1,370,000 in. lbs. |

If this bending moment is used on Chart A, the following final values are obtained:

Bending moment = 1, 370,000 in. lbs.
Breadth $(b)$ = 16 inches
Effective depth $(d)$ = 25 inches
Area of steel $(A_s)$ = 3.55 sq. in.

Checking these values by the formulas in the April issue for the conditions $(b = 16$ inches) and $(d = 25$ inches):

$$M = Kbd^2 = 138.7 \times 16 \times 25^2 = 1{,}390{,}000 \text{ in. lbs.}$$

$$A_s = pbd = 0.0089 \times 16 \times 25 = 3.56 \text{ sq. in.}$$

$$\text{D. L. Wt.} = \frac{16 \times 27}{144} 150 = 450 \text{ lbs. per ft.}$$

## Bending Moments

The Joint Committee Specifications make the following assumptions for bending moments:

The span length, 1, of freely supported beams and slabs, shall be the distance between centers of the supports, but shall not exceed the clear span plus the depth of beam or slab. The span length for continuous or restrained beams built to act integrally with supports shall be the clear distance between faces of supports. Where brackets having a width not less than the width of beam and making an angle of 45 degrees or more with the horizontal axis of a restrained beam are built to act integrally with the beam and support, the span shall be measured from the section where the combined depth of the beam and bracket is at least one-third more than the depth of the beam, but no portion of such bracket shall be considered as adding to the effective depth of the beam. Maximum negative moments are to be considered as existing at the ends of the span as defined above.

Beams and slabs of equal spans built to act integrally with beams, girders, or other slightly restraining supports and carrying uniformly distributed loads shall be designed for the following moments at critical sections:

(a) Beams and slabs of one span.
Maximum positive moment near center,

$$M = \frac{wl^2}{8} \quad \ldots\ldots\ldots\ldots \text{Eq. 1-B}$$

(b) Beams and slabs continuous for two spans only.
(1) Maximum positive moment near center,

$$M = \frac{wl^2}{10} \quad \ldots\ldots\ldots\ldots \text{Eq. 2-B}$$

(2) Negative moment over interior support,

$$M = \frac{wl^2}{8} \quad \ldots\ldots\ldots\ldots \text{Eq. 3-B}$$

(c) Beams and slabs continuous for more than two spans.
(1) Maximum positive moment near center and negative moment at support of interior spans,

$$M = \frac{wl^2}{12} \quad \ldots\ldots\ldots\ldots \text{Eq. 4-B}$$

(2) Maximum positive moment near centers of end spans and negative moment at first interior support,

$$M = \frac{wl^2}{10} \quad \ldots\ldots\ldots\ldots \text{Eq. 5-B}$$

(d) Negative moment at end supports for cases (a), (b), (c) of this section,

$$M = \frac{wl^2}{16} \quad \ldots\ldots\ldots\ldots \text{Eq. 6-B}$$

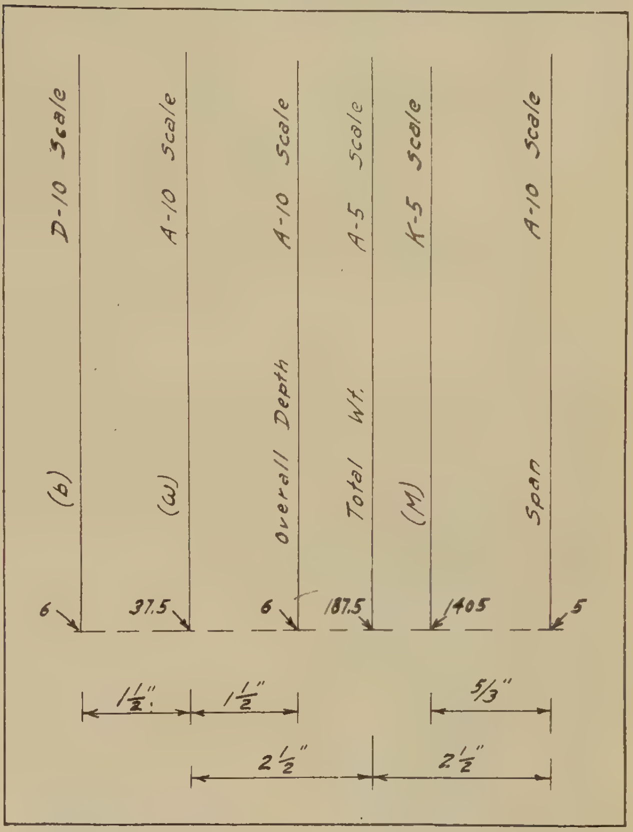


*Figure* 1-B

Chart B has been designed to give the bending moment for the conditions of Eq. 1-B and Eq. 3-B wherein $(M = \frac{wl^2}{8})$. Later details will be given for the adding of other moment values, but for simplicity they have been omitted from Chart B. The bending moments for other conditions of restraint can, however, be easily obtained by the use of a co-efficient which will make Chart B applicable to all conditions. If the unit load is multiplied by these co-efficients, the corrected load can then be applied to Chart B and the correct moment obtained. Likewise, the moment obtained from Chart B by using the actual load, can be corrected for any condition of restraint by using these co-efficients as multipliers.

TABLE 1-B

| Bending Moment Formula | Co-efficient to Be Used as Multipliers of Simple Span Conditions |
|---|---|
| $M = \frac{wl^2}{10}$ | 0.8 |
| $M = \frac{wl^2}{12}$ | 0.666 |
| $M = \frac{wl^2}{16}$ | 0.5 |

Thus, if a total uniform load of $(w = 800$ lbs. per ft.) is given for a condition requiring $(M = \frac{wl^2}{10})$, Chart B may be used with a unit load of

$$w = 0.8 \times 800 = 640 \text{ lbs. per ft.}$$

and the correct moment obtained. Likewise, if the load of (800 lbs. per ft.) were used on Chart B, the moment obtained should be multiplied by this same co-efficient.

### Construction of Chart B

The dead-load weight per linear foot of a concrete beam would be found by multiplying the volume per linear foot by the weight per unit volume. When the breadth and overall depth of the beam are expressed in inches, the equation becomes:

$$\text{D. L. Wt.} = \frac{(b)\ (\text{overall depth})}{144} 150 = \text{lbs. per ft.}$$

If the overall depth be represented by $(D)$, the expression then reduces to the form:

$$\text{D. L. Wt.} = 1.042\, b\, D = \text{lbs. per ft.}$$

This expression corresponds to the general nomograph expression:

$$C = L^{mn/r} \,.\, R^{m(1-n)} \qquad \text{Eq. 7}$$

requiring logarithmic co-ordinates. If values of $(b)$ are plotted on the left $(L)$ scale and values of $(D)$ on the right $(R)$ scale, then values of (D. L. Wt.) will appear on the central $(C)$ scale. As the range of values of $(b)$ and $(D)$ will be about the same, the same size co-ordinates will be used on both scales, making the ratio $(r = 1)$. Equating the general to the actual exponents:

$$\begin{cases} \dfrac{mn}{r} = \dfrac{mn}{1} = 1 \\ m(1-n) = 1 \end{cases}$$

Solving these two expressions simultaneously we get:

$$\begin{cases} n = \dfrac{1}{2} \\ m = 2 \end{cases}$$

In constructing Chart B, a $D$-10 scale was used for the $(b)$ and $(D)$ scale, while the unit dead-load scale was located midway between them $(n = \frac{1}{2})$ and the $A$-10 scale was used for its co-ordinates $(m = 2)$ which are one-half the size of those used for the $(D)$ scale.

The total weight of the beam is a function of the unit weight and the span. While really a separate chart requiring a separate isopleth for solution, the total weight scale has been added since the unit weight scale was already shown. When the unit weight is in pounds per linear foot, and the span in feet, the expression becomes:

$$\text{Total weight of beam } (W) = wl = \text{pounds}$$

This expression also resembles the general nomograph expression Eq. 7, and since both exponents are unity, as in the expression for unit weight, if equal co-ordinates are used on the $(w)$ and (1) scales, we would again have the relations:

$$\begin{cases} n = \dfrac{1}{2} \\ m = 2 \end{cases}$$

Thus the $(W)$ scale will be located midway between the $(w)$ and the (1) scales and have co-ordinates one-half the size of those used on them. So the $A$-10 scale will be used for values of the span (1), and the $A$-5 scale for values of the total weight $(W)$.

The bending moment for a beam of simple span is given by the expression:

$$M = \frac{wl^2}{8} \quad \ldots\ldots\ldots\ldots \quad \text{Eq. 1-B}$$

When the unit load $(w)$ is in pounds per linear foot and the span (1) in feet, this expression becomes:

$$M = \frac{12\, wl^2}{8} = \text{inch pounds.}$$

This expression also resembles the general nomograph expression Eq. 7, wherein we have

$$\begin{cases} \dfrac{mn}{r} = 1 \\ m(1-n) = 2 \end{cases}$$

The scales for the unit load $(w)$ and the span (1) have already been determined using equal co-ordinates, making the ratio $(r = 1)$. Substituting this value of $(r)$ and solving these last two expressions simultaneously, we get:

$$\begin{cases} n = \dfrac{1}{3} \\ m = 3 \end{cases}$$

Thus it will be seen that the moment scale $(M)$ must be one-third the distance from the (1) scale to the $(w)$ scale and its units one-third the size, which is satisfied by the $K$-5 scale.

The details for the construction of the original of Chart B are shown in Fig. 1-B, in which the construction isopleth was taken through the values:

Breadth of beam = 6 inches
Overall depth = 6 inches
Span = 5 feet

If a scale representing some other value of restraint than that used $(M = \frac{wl^2}{8})$ was desired, the spacing of the scales would be unaffected, also the size of the co-ordinates would be the same. Its value at the construction isopleth would, however, be changed. Thus, if $(M = \frac{wl^2}{12})$ was to be used at the construction isopleth it would have a value of:

$$M = \frac{wl^2}{12} = \frac{37.5 \times 5^2 \times 12}{12} = 938 \text{ inch pounds.}$$

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## R. W. Crum Appointed Director of Research Board

Professor F. H. Eno, chairman of the executive committee of the Highway Research Board of the National Research Council, has announced the appointment of Roy W. Crum of Ames, Iowa, as director of the board, effective April 1, 1928.

Mr. Crum's experience in research work well qualifies him for this position. After graduation from the Iowa State College in 1907 he was engaged on the engineer corps of the Pennsylvania Lines, following which he returned to Iowa State College as associate professor of civil engineering. He remained in this position for twelve years, during which time he was engaged in research work for the Iowa Experiment Station. Since 1919 he has been engineer of materials and tests with the Iowa State Highway Commission where he has conducted many highway research studies. Mr. Crum has been a member of the Committee on Character and Use of Road Materials since the organization of the board, and in 1925 he was appointed chairman of the culvert investigation conducted by the Highway Research Board.

Mr. Crum is the author of a number of important research papers. He is a member of the American Society of Civil Engineers, the American Society for Testing Materials and the American Concrete Institute and is active on several research committees of those organizations.

# Reinforced Concrete— New Architectural Possibilities

### Large Portion of Fourth Annual Meeting of Concrete Reinforcing Steel Institute Devoted to Discussions of Reinforced Concrete Design and Construction — Joint Building Code Adopted—Standardization of Steel Forms —Hart Presents Paper on "Reinforced Concrete—New Architectural Possibilities"

SEVERAL discussions of vital interest to concrete contractors and designers took place on the program of the fourth annual meeting of the Concrete Reinforcing Steel Institute, held at Biloxi, Miss., March 19th to 21st.

At one session of the meeting, the Joint Building Code, recently adopted as a tentative standard by the American Concrete Institute (see page 21, April issue), was also adopted by the Concrete Reinforcing Steel Institute as a tentative standard. This new concrete code, as will be remembered, was prepared jointly by the American Concrete Institute and the Concrete Reinforcing Steel Institute in an effort to present to designers a modern code which took into account the recent important developments in concrete construction. Its adoption by the Concrete Reinforcing Steel Institute will help to hasten its general incorporation into the various municipal, state and regional building codes that now restrict the use of concrete unnecessarily.

## Metal Forms Standardization

A second item, of especial importance to contractors, was a conference with the Division of Simplified Practice of the U. S. Department of Commerce in an effort to standardize "form dimensions for concrete ribbed floor construction." Chief Edwin W. Ely of the Division of Simplified Practice presided at this conference. At its close a series of recommendations were made for adoption after a referendum vote had been taken of the industry by the Department of Commerce.

*A typical example of the smaller monolithic concrete building described by Mr. Hart. This is the building of the Tea Garden Products Company, in San Francisco*

*In this church in Los Angeles, the architect has permitted the form marks on the reinforced concrete walls to remain. This is one of a number of similarly treated structures in Los Angeles*

Briefly, the following items constituted the recommendations made.

The list of stock sizes and dimensions were recommended as shown below.

| Width of Standard Forms Inches | Length of Tapers Inches | Total Contraction Inches | Depth of All Forms Inches | Widths of Special Filler Forms Inches |
|---|---|---|---|---|
| 20 | 36 | 4 | 6, 8, 10, 12, and 14 | 10 and 15 |
| 30 | 36 | 6 | 6, 8, 10, 12, and 14 | (No tapers) |

The depth of forms was interpreted to mean the vertical distance from the under side of the concrete slab above the center of the form to the bottom of the concrete joist.

Both square and tapered end forms are to comply with the dimensions in the above table as far as width and depth is concerned.

It was recommended that these provisions are to be effective July 1, 1928, subject to annual revision by the standing committee of the industry.

### "Reinforced Concrete—New Architectural Possibilities"

A very practical paper on the use of reinforced concrete filler or panel walls for buildings was presented by W. E. Hart, manager of the Structural Bureau of the Portland Cement Association. Mr. Hart treated his subject from the standpoint of design, architectural possibilities, quality of concrete required, treatment of exterior concrete surfaces and savings in construction costs. He described the type of building discussed in his paper as follows: "The construction consists of erecting a reinforced concrete building of any height and enclosing the building as it is erected with reinforced concrete walls. The forms for these walls are built in such a manner as to include practically all the architectural details and trim. When the forms are stripped, a monolith stands practically complete except for interior finish."

### Design Features

"As a basis for the structural design of buildings as discussed in this paper," said Mr. Hart, "let us conceive the simplest type of fireproof construction. The factory or loft building probably would give the greatest floor area at the lowest possible cost per square foot. The walls, columns and floor systems would be made of reinforced concrete placed by common labor with intelligent supervision. Rough holes would be left in the walls for windows, doors and other openings. Such a construction would represent the maximum structure at a minimum cost for materials and labor. From this point the building may be given any treatment desired in order that it may be suitable for the class of occupancy for which it was built. Such a construction can well serve as a foundation from which to design office buildings, hotels and apartments. In fact, this construction might well be used on fully 90 per cent of our present building programs.

"In such a building concrete may serve as a structural and architectural material. This concrete must be designed with care and the construction supervised by competent men. The concrete for this building is to be exposed to the action of the elements and for that reason must receive unusual care and attention in making and placing. The contractor should bid the concrete at a price that will permit the care and attention required by the architect. In other words, the concrete for this type of building must be recognized as a different concrete than that used on the normal building job, because in this case it has the additional function of finishing and decorating the building.

"Buildings using exterior walls of monolithic concrete have been used for factories and industrial developments in the central and eastern part of the United States with satisfactory results so far as housing the industry is concerned but exceedingly poor results from the architectural viewpoint. It has fallen to the lot of the architects and engineers on the Pacific Coast to demonstrate the practicability of using concrete successfully as a structural and architectural material.

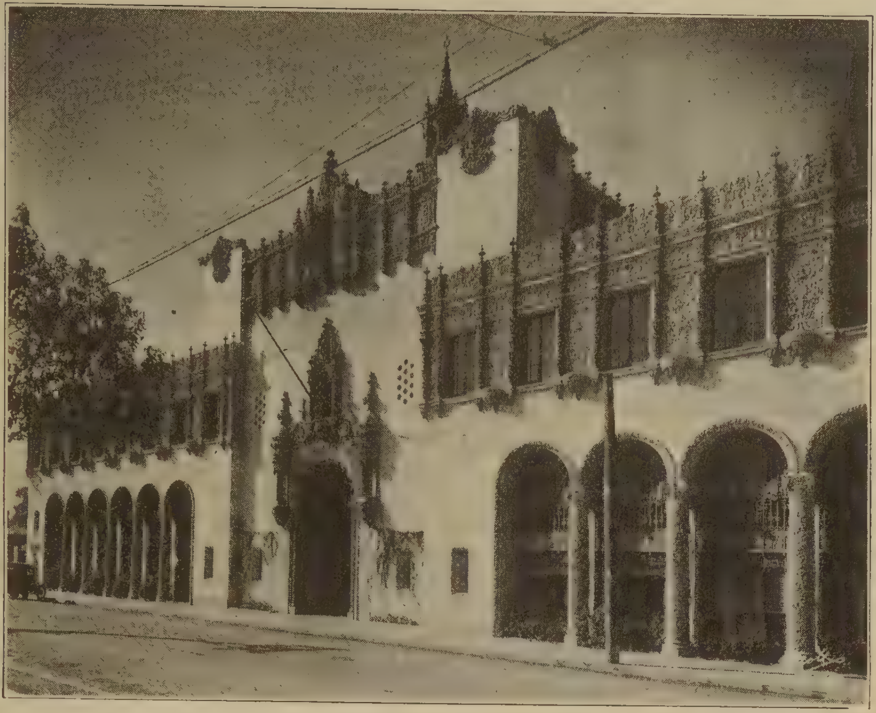
### Architectural Advantages

"Compare the architectural design of office buildings today with those built in 1900. The facade is simple, with straight lines and a minimum architectural treatment between the third or fourth floor belt course and the sky line. This is due in a great measure to the cost of carving and setting ornamentation. In other words, the architect has been forced for concrete reasons to reduce his architectural embellishment to a minimum. It is true that we all favor the general style of our buildings today over those of the earlier period but any architect will advise you that the cost of producing proper architectural treatment on general utility buildings such as offices, hotels and apartments has become prohibitive.

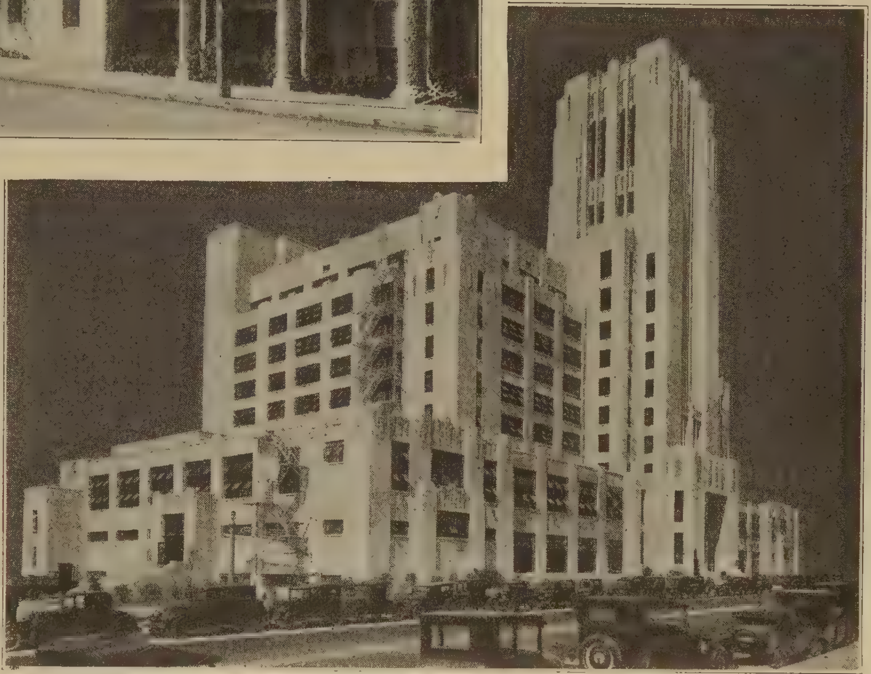
* * *

*The beamed ceiling in the Sunset Dining Room of the Pacific Coast Club at Long Beach, Calif., is decorated concrete, applied as described in the accompanying text*

* * *



Left. *All of the exposed wall surface, including the ornamentation was cast in monolithic concrete. This building, housing the Los Angeles Herald, illustrates the architectural treatments possible in the all-concrete structure*



Right. *The Sears-Roebuck building, Los Angeles. In the monolithic concrete building, such as this, it is possible to convert what would otherwise be a plain warehouse type of structure into a building of architectural distinction at a very small cost*

"The fact that economies must be practiced in present-day construction does not relieve the situation from the architectural standpoint. In other words, the architect still has the desire to design buildings with an embellishment suitable for the structure. The fact that concrete can be produced, where a duplication in ornament is permitted, more economically than any other form of treatment, makes this new material desirable from the architectural standpoint. It costs as much to make the first model in concrete as it does to carve the same model in stone. If the model is produced twice the original cost is cut by one-third. After four or five duplications have been made, the cost is so greatly reduced that this form of treatment does not become a serious item of cost.

"The illustrations used with this paper show conclusively that the exterior and exposed use of concrete must be a frank expression of the material. Designs to be done in concrete should not be the same as those of brick, stone or marble. Long pilasters should carry the eye from the ground to the sky line. Walls may be broken with windows, doors, arches or relief work but all should be in harmony with the general effect of the entire design. Embellishment should be so placed as to break up the large wall areas that would tend toward the unpleasant. One architect has said that, 'All the lower areas of a building must have a friendly surface.' In other words, these portions of the building that the public notice most should have refinement built into them. The balance of the structure may carry the rugged characteristic of the material. The entrance ways must be drawn carefully and the sky line may be decorated with a wealth of detail. After all the dominant note for the concrete building should be that of a monolith that has arisen out of the ground upon which it stands. It should leave the impression that it has always stood there and like the great Redwoods produce a picture in our mind of sturdiness sufficient to combat the elements for centuries.

## Type of Concrete Required

"The concrete for walls of this type must be of uniform composition throughout the entire area. The size and grading of the fine and coarse aggregate should be consistent throughout the job so that the concrete will be uniform.

"A mixture composed of one bag of cement to six or six and one-half gallons of water will produce a concrete wall that will resist weathering and prevent the absorption of moisture into the wall. The consistency or workability of the concrete is very important. The concrete should be of such a consistency that it will go into all of the corners and angles of the forms without excessive spading but the mix should not be so wet that after the concrete has been in the forms for ten or fifteen minutes water rises to the surface. Each batch of concrete should have the aggregates and water measured very carefully so that the density of every batch will be the same.

"It is also important that the concrete be evenly distributed along the forms and not allowed to flow by gravity from the point of discharge to any point in the wall. The form should be filled evenly and where possible the concrete placed in one continuous operation. Any breaks in the placing should be made on definite lines or along the bottom of window openings.

"Reinforced concrete walls have three distinct functions in buildings of this type. In the first place they replace masonry walls in ordinary construction and enclose the building; second, they offer greater stability than any other form of enclosure. Such walls may be figured as taking a definite part of the normal wind stress, thus relieving the columns of part of the stress or reducing their size. The third point and the one that has greater consideration in this paper is the employment of these walls as a part of the architectural scheme of decoration.

"Monolithic walls which are a part of the structure tend to tie it together and resist horizontal stresses. Since walls are a necessary part of any structure and since concrete walls can be provided with additional reinforcement, at slight expense, sufficient to provide full stability to the structure, it is only logical that the additional virtue of the monolithic wall should be put to good use in any locality where wind storm and earthquake are a problem.

## Lower Cost

"Most building codes require a brick filler or panel wall to be at least 12 inches thick while the same wall in reinforced concrete need only to be 8 inches. On this basis, the cost per square foot of wall area will favor concrete. Even though the concrete cost may be more it should be remembered that greater rigidity has been secured with a considerable reduction in the final load on the footings due to the fact that these filler walls also serve as a final finish of the exterior of the buildings. In other words, the load of a facing material need not be considered in these calculations.

"A great many factors enter into the cost of buildings so that it is difficult to draw comparisons that are reasonably accurate. Therefore the figures given below naturally involve some tolerance in either direction. It is felt, however, that the differences in cost between the two types of construction should serve as a guide. These figures have been supplied by competent contractors and represent the same class of occupancy in each case. A structural steel frame hotel with masonry walls, face brick and cut stone trim, costs 67 cents per cu. ft. A reinforced concrete frame apartment hotel with brick panel walls and a face brick exterior costs 65 cents per cu. ft. Six apartment hotels, using a reinforced concrete frame with monolithic panel walls and stucco exterior, vary in cost from 47 cents to 52 cents per cu. ft. Published costs for stucco treatment on monolithic walls consisting of a dash coat for bond, a brown coat for strengthening the surface and a colored finish coat varies from $1.10 to $1.50 per sq. yd.

"All of the above figures are based on labor costs in southern California which are considerably lower than those in the cities east of the Rocky Mountains. However, the differential between monolithic walls and masonry walls is of significance. Approximately the same relationship in costs should exist in the central part of the United States.

"The reinforcement for 6-inch walls usually consists of ½-inch bars on 12-inch centers, placed in the center of the wall. For an 8-inch wall two lines of ½-inch bars are placed on each face with the proper amount of fireproofing over the bars. All windows, doors or other openings must be properly protected from diagonal cracking. To eliminate these cracks two ⅝-inch bars are placed at the top and bottom of each window and over the top of each door. These bars extend into the wall at least 30 inches on either side of the opening. Further protection consists of two ⅝-inch bars placed diagonally or at 45 deg. over the corners of each opening. This practice is the rule for the school boards in Seattle and Portland where the concrete is subjected to considerable volume changes due to the great precipitation the year around and is followed on all work in California.

## Exterior Treatment

Concrete has another application in the decoration of a building. In the past it has been the practice to plaster and paint the ceilings of lobbies and lounging rooms of hotels and clubs. Architects have realized, however, the possibility of including the structural members of a building as a part of their decorative scheme. In other words, concrete beams and girders may be so designed and built as to become an integral part of the decoration of large rooms. The application of paints and stains to load bearing members adds a strength and dignity which could not be created by any amount of ornamentation that masks or hides from view the structural members.

"In designing a beamed ceiling which is to be stained and painted, it should be realized by the architect that the final effects depend largely upon the quality of the concrete surface upon which the decorations are to be applied. These surfaces should be free from blemishes and the forms should be so placed as to hold their alignment. Textures may be produced in the concrete surfaces by the use of undressed lumber for the forms and by means of specially prepared plaster molds."

## Other Papers

In an interesting paper upon the subject, "Coming Changes in Industry," Dr. John Thom Holdsworth, Professor of Economics, University of Miami, sounded a note of optimism as regards business and business relations of the future. "The great economic problem of tomorrow," he said, "is the adjustment of steadily increasing production to the needs of consumption. Broadly speaking, production never can quite overtake consumption. Consumption is indefinitely expansive. The man who, or the industry that, creates a new want and satisfies it will continue to reap rich rewards."

President Routh's address, given at the opening of the meeting, summarized the work of the institute and outlined the work of its various committees. He stressed the need of closer relationship between the rolling mills and the fabricators of reinforcing steel. At another session C. Louis Meyer presented a paper describing the layout, mechanical processes and investment of a modern fabricating plant.

President Geo. E. Routh, Jr., of Chicago; Vice-President C. Louis Meyer of Omaha; and Treasurer Hugh J. Baker of Indianapolis were reelected for another year. A. E. Lindau of Chicago was reelected as a director for a term of three years and O. W. Irwin of Youngstown was elected to serve as director for a similar period in place of Gustave Kahn whose present duties require his residence in California. The directors of the institute reelected M. A. Beeman of Chicago as secretary and continued the appointment of R. W. Johnson as engineer.

# The A. B. C.'s of Good Concrete

## Some of the Factors That Affect the Quality of Concrete—Types of Admixtures—What They Are Used for—How to Use Them—Their Effect on the Quality of Concrete—Precautions

## Part VIII—The Use of Admixtures

HERE is the definition of admixtures, usually used in textbooks and scientific papers: "Admixtures are substances other than cement, aggregates and water which are added to concrete mixtures for the purpose of imparting to the latter certain improved qualities."

These "improved qualities" may be aimed at making the concrete more waterproof, stronger, more uniform, more workable, more resistant to wear, to aid curing or, to make winter work more satisfactory. To perform these various functions, a number of types of admixtures have been produced, each aimed at securing one or more of these "improved qualities."

There can be no doubt but that the use of admixtures is steadily gaining favor. Many concretors consider them an additional "factor of safety" that will help to assure concrete of the quality desired.

Tests made and reported by authorities agree that the strength of concrete containing proper amounts of admixtures will not decrease more than the percentage of admixture used. In some instances strength is increased slightly by their use. But the real value of admixtures does not lie so much in greater final strength as it does in some of the other qualities mentioned.

### Workability

Probably the most common reason for the use of admixtures is to get a more workable concrete. The more workable the mix is, the lower will be the cost of placing the concrete and the more satisfactory will the job be when the forms are removed. It is fortunate, too, that when a mix is workable, it will usually make for a more uniform concrete.

Workability is promoted by four types of admixtures:—

(1) Those that are inert in the mix and act principally as a lubricating agent. They include such types of fine aggregate as fine silica, pumicite, some diatomateous earths, limestone dust, kaolin, clay and other similar materials.

(2) Such materials as hydrated lime, blast furnace slag, natural cements, etc., which add to the preceding properties the ability to react in the mix and have some cementitious value in themselves.

(3) Materials that have a water-holding, sponge effect such as diatomite and other porous or cellular materials. Such admixtures help to fill voids and act as an oil in the mix, permitting a better flow.

(4) Those materials that form a "gel" or colloid in the mix.

As has been pointed out in other articles in this series, the strength of concrete depends primarily on the amount of water used in the mix for each sack of cement. But strength is not the only quality desired. Recently there has been much emphasis on *uniformity* and appearance. Both of these last two qualities are often affected by the use of such admixtures as are mentioned above. Their use has been found to: (1) prevent segregation of aggregate, (2) help the flowability of the concrete, (3) produce more uniform and better appearing concrete, (4) increase the *average* strength of the concrete placed in many instances, (5) increase the yield under favorable conditions.

### Waterproofing

Very often concretors desire particularly to make the concrete they place "water-tight," so as to prevent leakage or to prevent water absorption which causes dampness or to prevent, as far as possible, expansion and contraction. It has been shown that one of the chief reasons for the disintegration of concrete is porosity. Other things being equal, the most durable concrete is that which is the densest.

Much can be done to make concrete dense by following the suggestions as to proportioning, mixing, water content and placing given in previous articles in this series. All these factors have a definite influence in making concrete water-tight. It would be folly to expect that any or all of the simple requirements for making good concrete can be ignored and that all that is necessary is to add an admixture and the concrete will be water-tight.

It can't be done that way. But, when the requirements for making good concrete are watched and complied with, then it is often possible to make concrete still more water-tight by using an admixture. There are, of course, certain types of surface coatings which are very valuable, but in this article we will talk only about integral waterproofing, that is, waterproofing secured through the use of materials added to the mix.

There are a number of types of admixtures marketed for this purpose. Integral waterproofing can be secured by:

(1) Filling voids with fine, inert material such as fine sand, silica, pumice, clay, etc.

(2) The use of materials that swell when placed in water, forming a "gel" or colloid.

(3) The use of water repellent substances.

A fundamental requirement of all such admixtures is that they be evenly distributed throughout the mix. To this end care must be taken that the instructions of the manufacturers be carefully complied with.

Another advantage of the use of water repellent admixtures is that, in addition to forming a lining in the pores which resists the *absorption* of water, they help to retard the *evaporation* of the mixing water. The retention of this water tends to assist in the hydration of the cement and therefore helps to make better concrete.

### Accelerators

Recently there has been a very definite desire on the part of concretors to put concrete into use sooner than ordinary mixing and curing methods permit. They have searched for a method of accelerating the hardening of the concrete. The advantages of such early strength are readily appreciated, both in pavement construction and in general structural work. Often, too, there are special jobs whose early completion and use mean considerable economy.

There are types of admixtures which have been found very helpful in cases of this kind. Many tests have shown that when such admixtures are used properly they have a very definite effect in speeding up the hardening of concrete, especially at early periods. Such admixtures, usually of calcium chloride or having calcium chloride as a base, may be secured in liquid and powder form and must be added to the mix strictly in accordance with the manufacturer's instructions.

Here again, it must not be assumed that the admixture will do it all. It is very necessary that every precaution be taken to secure a high quality concrete. The admixture simply acts as a special additional feature that can be taken advantage of when all other conditions are complied with.

Such admixtures are also of value when concrete is being placed during cold weather. They help to prevent freezing of the concrete before it has hardened and hasten the hardening process.

### Curing

In order to secure proper curing of concrete, certain conditions must be present. The concrete must be kept warm and sufficient moisture must be present to permit the hydration of the cement.

In cool weather, certain types of admixtures will help to provide these conditions and in recent years the use of an admixture of this type has been considered on some paving jobs as being sufficient to meet all curing needs. The admixture attracts water, holding it until it is needed for the hydration of the cement. It then releases the water gradually, thus giving the cement the water it requires, which, of course, is the purpose of all methods of curing.

### Conclusion

In this article, we have attempted only to describe the principal uses of concrete admixtures and to list the types of admixtures used to meet these needs. No specific names have been mentioned.

There are a vast number of admixtures on the market, some of which are of real value to the contractor for the uses described. There are, also, some materials being sold as admixtures which have little or no influence on the concrete in which they are used.

It is necessary for the concretor to exercise care in his selection of admixtures and then to use them carefully and in the proper amounts. Improper use of admixtures will result in harm, defeating the aim of the user. It is safest to ask the engineering departments of the manufacturers for precise instructions regarding the use of their product and then follow these instructions rigidly.

## Novel Method of Chimney Construction

A novel method of chimney construction used in securing the additional sectional area required to take off larger volumes of gases has recently been put to practical tests in Great Britain. There being no space available for building an entirely new and separate chimney, it was decided to construct the larger chimney round the smaller one and then remove the latter, as the loss consequent on stopping work while a new chimney was built was too great to be considered.

It was found that the foundations were large enough and strong enough to take the new sructure, which was therefore built upon it, due care being taken to obtain a proper connection between the foundation and the new shell. This was done by concreting the newer and larger diameter on to the bottom and tapering portion of the old, and thus through this portion of the old chimney stresses were communicated to the foundation.

The new chimney is 1 ft. 10 in. larger in diameter than the old one. No scaffolding was used, the necessary platforms being fixed on the exterior of the old and narrower chimney. It was also essential that the inner forms should not touch the old chimney, as wind movements would have caused improper hardening of the concrete.

## Modernizing of Homes Object of New Organization

The modernizing of the existing homes in the United States is the job undertaken by the new Home Modernizing bureau of the National Building Industries. The department was organized in Chicago on April 11th and is composed of 44 associations, corporations and other factors in the building field.

Necessary funds to get the organization under way were secured. The meeting voted to incorporate a non-profit organization, elected officers, engaged a secretary and empowered a committee to open headquarters and to begin the work of promoting modernization of homes.

G. E. Warren, of the Portland Cement Association, represents the cement industry in this movement.

## Correction

CONCRETE, on page 14 of the April issue, erroneously referred to Emil Praeger of B. G. Goodhue Associates, as the architect of the new Los Angeles city hall.

Mr. Praeger was, instead, the architect on the new Los Angeles public library.

# *Bookkeeping—*
# The Key to Profit
# *in Products Plants*

## The Fourth Article in This Series Showing How Accurate Bookkeeping Increases Profits—Cost Computations—Cost per Unit—Use of Cost Summary—Non-Manufacturing Overhead—Operating Cost per Unit Sold—Selling Cost—Total Cost per Unit

By **WILLARD R. GINDER, C. P. A.**
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Consulting Accountant, National Concrete Products Association

## Part IV

IN Figure 9, we present a form for computation of such general cost data as we have suggested for various uses.

Provision has been made for computing data regarding material, upon bases of both one month and the last twelve months. No great variation should occur in material cost per dry-weight pound and per one-sack batch, between the two periods, except that current month data might reflect slight lowering of costs due to improvements in methods.

If a plant manufactures two kinds of blocks, such as sand blocks, and cinder or Haydite blocks, a separate material bracket will be required for each type of aggregate used. In fact, separate material and direct labor accounts, and statistical records should also be maintained for each distinct type of block made.

All other data is computed upon the basis of twelve months, so that variations in expenses and rate of production from month to month, with consequent wide variations in cost data, will be avoided.

Total cost of each operation for the last twelve months, as respectively called for on lines Nos. 6, 13, 18, and 21, is obtained from the overhead distribution sheets. This data may be kept on a memorandum sheet in the ledger, in such a way as to provide the required amounts, as shown in the box on this page.

Operation C expenses or overhead are divided among the molding machines as equitably as possible, in accordance with the methods used on the main overhead distribution sheet.

A suggested form of monthly material report and summary is presented in Figure 10. It will be noted that this form provides for nine classes or kinds of material. If more brackets are required, a larger form may be designed or two sheets may be used per month.

A form for use in preparing monthly and year to date statements of units produced, sold and in inventory, with dry-weights, is presented in Figure 11.

For computing cost data, the following records must be maintained in addition to those already specified:

(1) Number of batches mixed in each mixer per month.
(2) Number of hours operated by Operation A, B, and C machinery per month.

*Overhead per Distribution Sheet*

| | Oper. A | Oper. B | Oper. C<br>Nos. 1—2—3 | Oper. D |
|---|---|---|---|---|
| 1927 | | | | |
| January | | | | |
| February | | | | |
| March | | | | |
| April | | | | |
| May | | | | |
| June | | | | |
| July | | | | |
| August | | | | |
| September | | | | |
| October | | | | |
| November | | | | |
| December | | | | |
| Total | | | | |
| 1928 | | | | |
| January | | | | |
| Total | | | | |
| Deduct January, 1927 | | | | |
| Twelve months to January 31, 1928 | | | | |
| February | | | | |
| Total | | | | |
| Deduct February, 1927 | | | | |

These may be kept in the way found most convenient.

It is suggested that provision be made for all required information to appear on a daily plant report to the office.

In Figure 12 we present a form of cost sheet, upon which the cost of an individual style and size unit may be computed, in accordance with the methods previously suggested.

Most of the spaces on this form are filled in from data already in hand, and the computations on the sheet are comparatively simple and few in number. It will therefore be found that very little time is required to make a unit cost computation.

This sheet might be enlarged and contain sufficient

*Figure 9*

## STANDARD CONCRETE PRODUCTS COMPANY

### COMPUTATION OF GENERAL COST DATA

Period of ______ Months, Ended ____________, 192___.

| MATERIAL | | Current Month | Period to Date |
|---|---|---|---|
| 1. Cost of Material Used* | | xx | xx |
| 2. Total Dry-Weight Produced | | xx | xx |
| 3. Material Cost per Dry-Weight Pound Produced (1 ÷ 2) | | xx | xx |
| 4. Number of One Sack Batches Mixed | | xx | xx |
| 5. Material Cost per One Sack Batch (1 ÷ 4) | | xx | xx |
| **MATERIAL PREPARATION** | | **Time Labor** | **Overhead** |
| *Operation A* | | | |
| 6. Total Cost for Period (Excluding Piece-work Labor) | | xx | xx |
| 7. Total Dry-Weight Produced During Period | xx | | |
| 8. Cost per Dry-Weight Pound Produced (6 ÷ 7) | | xx | xx |
| 9. Number of One Sack Batches Mixed During Period | xx | | |
| 10. Cost per One Sack Batch (6 ÷ 9) | | xx | xx |
| 11. Number of Hours Operated During Period | xx | | |
| 12. Cost per Hour (6 ÷ 11) | | xx | xx |
| *Operation B* | | | |
| 13. Total Cost for Period (Excluding Piece-work Labor) | | xx | xx |
| 14. Cost per Dry-Weight Pound Produced (13 ÷ 7) | | xx | xx |
| 15. Cost per One Sack Batch (13 ÷ 9) | | xx | xx |
| 16. Number of Hours Operated During Period | xx | | |
| 17. Cost per Hour (13 ÷ 16) | | xx | xx |

| MOLDING AND CURING | Totals | Machine No. 1 | Machine No. 2 | Machine No. 3 |
|---|---|---|---|---|
| *Operation C* | | | | |
| Expenses for Period: | xx | xx | xx | xx |
| Power | xx | xx | xx | xx |
| Repairs | xx | xx | xx | xx |
| Pallet Cleaning & Oiling | xx | xx | xx | xx |
| Building Space | xx | xx | xx | xx |
| Insurance & Depreciation | xx | xx | xx | xx |
| Supervision | xx | xx | xx | xx |
| 18. Totals | xx | xx | xx | xx |
| 19. Hours Operated During Period | | xx | xx | xx |
| 20. Overhead Cost per Hour (18 ÷ 19) | | xx | xx | xx |
| *Operation D* | | | | |
| 21. Total Expense for Period (Operation D Only) | | | | xx |
| 22. Total Direct Labor for Period (Operation D Only) | | | | xx |
| 23. Expense per $1.00 of Direct Labor (21 ÷ 22) | | | | xx |

*Excluding Face Materials.

brackets to compute costs of several styles and sizes. If this is done, the general data at the top of the sheet will apply to each cost computation on the sheet, and need not be repeated.

A summary of the cost of any unit may be presented as follows:

Material (Subdivided as follows, if desired):
  Cement: Purchase Cost
    Freight, etc.

  Aggregate: Purchase Cost
    Freight, etc.

  Face Materials

    TOTAL
Material Preparation
  Direct Labor
  Overhead

Prepared Material Cost
Molding
  Direct Labor
  Overhead

Curing and Storing
  Direct Labor
  Overhead

Total Manufacturing Cost

RECAPITULATION
Materials (at laid-down value)
Direct Labor
Overhead

  Total Manufacturing Cost

### Use of the Cost Summary

In comparing such a cost summary with a similar one prepared for a prior period or for another plant, it will be easy to trace any difference in totals to the major items composing it. Detailed comparison of analyses of these items will then lead to the reasons for the difference.

For example, a difference of .003 may be found between the cost of an 8-inch standard unit, for one period as compared with a prior period. Comparison of the cost summaries might show that most of the difference is in overhead, while small portions of it are in direct labor and material. Further comparison of material costs might then show that the difference in material costs is all contained in handling and storage charges.

Comparison of total manufacturing overhead expense for the two periods might show little difference, and no material change may have occurred in labor piece-work or hour rates.

We would then turn to our total dry-weight produced during the two periods, or to the records of the number of one-sack batches mixed during the two periods. Here we would probably find that total production for one period was fifteen per cent greater than for the other,

*Figure* 10

## STANDARD CONCRETE PRODUCTS COMPANY

### MATERIAL SUMMARY

Month Ended ______________________, 192 .

| | Cement | | | Aggregate No. 1 | | | Aggregate No. 2 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sacks | Price | Amount | Yards | Price | Amount | Yards | Price | Amount |
| 1. Inv.—1st of Month | | | | | | | | | |
| 2. Purchases for Month | | | | | | | | | |
| 3. Freight for Month | | | | | | | | | |
| 4. Cartage for Month | | | | | | | | | |
| 5. Testing for Month | | | | | | | | | |
| 6. Handling for Month | | | | | | | | | |
| 7. Storage for Month | | | | | | | | | |
| 8. Total—Lines 1 to 7 | | * | | | * | | | * | |
| Disposition: | | | | | | | | | |
| 9. Used in Mfg. Block | | | | | | | | | |
| 10. Sold | | | | | | | | | |
| 11. Used—Other Purposes | | | | | | | | | |
| 12. Total—Lines 9 to 11 | | | | | | | | | |
| 13. Inv.—End of Month | | | | | | | | | |
| 14. Total—Lines 12 & 13 | | | | | | | | | |

| | Chloride | | | Lime | | | Sand | | |
|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Price | Amount | Quantity | Price | Amount | Quantity | Price | Amount |
| 1. Inv.—1st of Month | | | | | | | | | |
| 2. Purchases for Month | | | | | | | | | |
| 3. Freight for Month | | | | | | | | | |
| 4. Cartage for Month | | | | | | | | | |
| 5. Testing for Month | | | | | | | | | |
| 6. Handling for Month | | | | | | | | | |
| 7. Storage for Month | | | | | | | | | |
| 8. Total—Lines 1 to 7 | | * | | | * | | | * | |
| Disposition: | | | | | | | | | |
| 9. Used in Mfg. Block | | | | | | | | | |
| 10. Sold | | | | | | | | | |
| 11. Used—Other Purposes | | | | | | | | | |
| 12. Total—Lines 9 to 11 | | | | | | | | | |
| 13. Inv.—End of Month | | | | | | | | | |
| 14. Total—Lines 12 & 13. | | | | | | | | | |

| | Gravel | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Price | Amount | Quantity | Price | Amount | Quantity | Price | Amount |
| 1. Inv.—1st of Month | | | | | | | | | |
| 2. Purchases for Month | | | | | | | | | |
| 3. Freight for Month | | | | | | | | | |
| 4. Cartage for Month | | | | | | | | | |
| 5. Testing for Month | | | | | | | | | |
| 6. Handling for Month | | | | | | | | | |
| 7. Storage for Month | | | | | | | | | |
| 8. Total—Lines 1 to 7 | | * | | | * | | | * | |
| Disposition: | | | | | | | | | |
| 9. Used in Mfg. Block | | | | | | | | | |
| 10. Sold | | | | | | | | | |
| 11. Used—Other Purposes | | | | | | | | | |
| 12. Total—Lines 9 to 11 | | | | | | | | | |
| 13. Inv.—End of Month | | | | | | | | | |
| 14. Total—Lines 12 & 13 | | | | | | | | | |

*Obtain by dividing total of amount column by total of quantity column.

*Figure 11*

STANDARD CONCRETE PRODUCTS COMPANY

PRODUCTION, SALES AND INVENTORY DATA

Month Ended ______________, 192____.

| Style and Size | State Actual Quantities Here | | | | | | State Dry-Weight Totals Here | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1. Inventory 1st of Month | 2. Blocks Manuf't'ed | 3. Blocks Purchased | 4. Totals | 5. Blocks Sold | 6. Inventory End of Mo. | 1. Inventory 1st of Month | 2. Blocks Manuf't'ed | 3. Blocks Purchased | 4. Totals | 5. Blocks Sold | 6. Inventory End of Mo. |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Report blocks used in construction, etc., in Column No. 5, marked "C."
Report blocks broken in Column No. 5, marked "B."
If any item in Column No. 6 was checked physically: Mark it *.

Place any shortage found, in Column No. 5, marked *.
Place any overage found, in Column No. 2, marked *.
If blocks are sold wholesale to another plant in courtesy, mark "W."

which accounts for the difference in overhead per unit. The difference in direct-labor costs will then probably be found to be due to lower productive effort on the part of men on time basis, repetition of which may be guarded against in the future.

Our investigation has given us definite data regarding the effect of variation in rate of production upon costs.

A similar difference might be found between the cost of similar units in two different plants, and an investigation similar to the above might disclose that the trouble lies in the size of the mixer in the high cost plant. This plant might have a mixer which is too small, and too much attention may have been given to keeping down the proportion of cement in the mix, whereas an increase in the proportion of cement and a decrease in mixing time would effect a net reduction in total manufacturing costs, to say nothing of the saving which might be made possible by installation of a larger mixer.

Comparison of results among plants, such as that illustrated above, is one of the advantages attendant upon adoption of uniform or standard procedure by the industry.

## Non-Manufacturing Overhead

### Operating Expenses

As previously noted, the term "Overhead Expense" includes all items of expenditure except those made for purchases of manufacturing material, merchandise for resale, direct labor and items which may be properly capitalized.

Expenses which are not included in computing manufacturing cost have been termed "Operating Expenses" by us, and consist of the following:

Portion of Office Expenses;
General Administrative Expenses;
Selling Expenses;
Delivery Expenses.

The term "Manufacturing Cost" is generally understood to exclude these items, and sound accounting practice requires their exclusion in computing values of inventories, which are to be used in determining profit and loss and which are to be placed on the Balance Sheet. They therefore become direct charges against the gross profit realized from sales of product. It will be easily understood, therefore, that operating expense per unit should be computed on the basis of the units sold during any given period, and not upon the units manufactured.

Total operating expense for a period, or the average per month, may be obtained directly from the books or trial balances without difficulty. The accounts containing these expenses are grouped in the General Ledger, so that the total of each class of operating expense may be easily obtained. However, equitable allocation of operating expenses to specific type and size units, so as to obtain operating expense per unit sold, presents something of a problem.

### Operating Expenses per Unit Sold

Office and administrative expenses may be considered to vary in proportion to selling price, and office and administrative expense per unit may be determined by first computing office and administrative expense per $1.00 of gross sales, and multiplying the result obtained by the selling price of each type and size unit under consideration.

Delivery expense may, in the absence of other data, be considerd to vary in proportion to either gross volume or weight, and inasmuch as dry-weights have been suggested for other uses, we will assume that dry-weight

*Figure 12*

### STANDARD CONCRETE PRODUCTS COMPANY
### COMPUTATIONS OF MANUFACTURING COSTS PER UNIT

For Period of ........ Months, Ended ........................, 192.......

| GENERAL DATA | |
|---|---|
| A1. Material Cost per Dry-Weight Pound | xx |
| A2. Cost per Dry-Weight Pound—Operations A & B—Time Direct Labor | xx |
| A3. Cost per Dry-Weight Pound—Operations A & B—Overhead | xx |
| A5. Molding Machine No. 1 Hour Rate | xx |
| A6. Molding Machine No. 2 Hour Rate | xx |
| A7. Molding Machine No. 3 Hour Rate | xx |
| A8. Operation D Overhead per $1.00 of Direct Labor | xx |

| STYLE AND SIZE UNIT | | Material | Direct Labor | Overhead |
|---|---|---|---|---|
| 1. Dry-Weight per Unit ......xx...... Pounds | | | | |
| 2. Material Cost (1 × A1) | | xx | | |
| 3. Face Material (if any) | | xx | | |
| 4. Piece-work Direct Labor—Operations A & B | | | xx | |
| 5. Time Direct Labor—Operations A & B (1 × A2) | | | xx | |
| 6. Overhead—Operations A & B (1 × A3) | | | | xx |
| 7. Piece-work Direct Labor—Operation C | | | xx | |
| 8. Time Direct Labor—Operation C | | | xx | |
| 9. Average Number Molded per Hour ........ xx Machine No. | | | | |
| 10. Overhead—Operation C (A5-6 or 7 ÷ 9) | | | | xx |
| 11. Piece-work Direct Labor—Operation D | xx | | | |
| 12. Time Direct Labor—Operation D | xx | | xx | |
| 13. Overhead—Operation D (12 × A8) | | | | xx |
| 14. Totals | | xx | xx | xx |

data is at hand, and therefore suggest that delivery expense per unit be computed upon the dry-weight basis.

It may be that delivery is made by outside draymen, at fixed prices per unit or per load, and that loading labor is paid on a piece-work basis. In such cases, delivery expense per unit may be computed from the delivery and loading rates in force, but the results obtained should be carefully checked against total delivery expense for the period as shown by the books.

Many plants sell blocks f. o. b. yard, and charge fixed rates per unit for delivery. It is suggested that such delivery charges be kept separate from sales, and credited to an account termed "Delivery Income." If this is done, the credits contained in the delivery income account for any period may be readily compared with the total delivery expense for that period. Such comparisons may be found of considerable value.

It seems to be practically impossible to find any fixed characteristic, in proportion to which selling expense will vary. There may be a few plants in which selling expense may be considered to vary in proportion to some fixed characteristics of the product, such as wall area occupied per unit, but what is true of one plant may not apply at all in another.

Some of the fixed bases, upon which selling expense might be allocated, are as follows:

Gross volume per unit;
Weight per unit;
Dry-weight per unit;
Wall area occupied per unit;
Selling price per unit;
Manufacturing cost per unit;
Gross profit per unit;

but each has disadvantages, the chief of which is that sales resistance does not necessarily vary in proportion to any fixed characteristic. In the absence of a better one, and inasmuch as dry-weight data has already been suggested for a number of other uses, it is suggested that selling expense per unit be determined on the dry-weight basis.

Selection of such an arbitrary basis, for allocation of selling expense to specific type and size units, may be deemed unsatisfactory. If so, experience may indicate the relative sales resistance encountered by each type and size unit in any plant, and a basis upon which to equitably allocate selling expense may be developed to suit that particular plant.

The computations for allocating office and administrative expense on the selling price basis, and delivery and selling expenses on the dry-weight basis, are expressed in formula form as follows:

> Total Office and Administrative Expenses divided by Total Sales equals Office and Administrative Expense per $1.00 of Sales.
>
> Selling Price per Unit multiplied by Office and Administrative Expense per $1.00 of Sales equals Office and Administrative Expense per Unit.
>
> Dry-Weight per Unit multiplied by Number of Units Sold (one type and size) plus Dry-Weight per Unit multiplied by Number of Units Sold (next type and size) plus, etc. (each other type and size sold) equals Total Dry-Weight Sold.
>
> Total Selling Expense divided by Total Dry-Weight Sold equals Selling Expense per Pound of Dry-Weight Sold.
>
> Total Delivery Expense divided by Total Dry-Weight Sold equals Delivery Expense per Pound of Dry-Weight Sold.
>
> Delivery Expense per Pound of Dry-Weight Sold multiplied by Dry-Weight per Unit equals Delivery Expense per Unit.
>
> Selling Expense per Pound of Dry-Weight Sold multiplied by Dry-Weight per Unit equals Selling Expense per Unit.

## Total Cost per Unit

Inasmuch as operating expenses apply only to units sold, any computation of total cost per unit must be on the basis of units sold. Total cost is often, therefore, termed "Sold Cost," in contradistinction to manufacturing cost or manufactured cost.

Total cost per unit consists of manufacturing cost per unit plus operating expense per unit, and the main purpose for which it is used is determination of net profit obtained per unit of each type and size. It is suggested that this be done somewhat as follows:

For any type and size unit—

| | | |
|---|---|---|
| Selling Price | | $---------- |
| Less: Reserve for Discount | $---------- | |
| Allowance for Delivery Loss and Breakage | ---------- | ---------- |
| Net Selling Price | | ---------- |
| Manufacturing Cost | $---------- | |
| Operating Expense | ---------- | |
| Total Cost | | ---------- |
| Net Profit | | $---------- |

## St. Francis Dam Failure

*(Continued from page 24)*

disaster to others who have no control over the design, construction and maintenance of the works. The police power of the state certainly ought to be extended to cover all structures impounding any considerable quantities of water.

### The City of Los Angeles Report

The committee of experts appointed by Los Angeles to investigate the St. Francis dam collapse, headed by Dr. Elwood Mead, in making a report, also blamed the catastrophe on the defective foundations of the dam.

The committee's conclusion, after a thorough inspection of the dam site and an investigation of the earth formation under it, was as follows:

"It is the belief of this committee that the dam failed because it rested on a defective foundation."

The other two members of the committee with Dr. Mead were General Lansing H. Beach and Louis C. Hill.

Prior to the report of the Mead committee another commission of experts named by District Attorney Asa Keyes had reported that the foundations of the structure had been faulty.

Though not attempting to fix responsibility for the deaths of the more than 400 persons in the flood that swept through the broken dam, the body of engineers delegated by District Attorney Keyes to investigate the catastrophe, put it as their belief that a sufficiently thorough examination of the geological formation in San Francisquito canyon had not been made.

The dam, according to the engineers, was built on rock formations which softened with saturation and consequently were unsuited to carry the enormous load of the dam.

"It was the conclusion of the board," read the report placed before the coroner's inquest by Edward L. Mayberry, one of the engineers, "that the dam was constructed without a sufficiently thorough examination and understanding of the foundation materials upon which the dam was constructed."

The findings of this body, composed of E. L. Mayberry, Colonel Charles T. Leeds and J. Gordon Clark, were presented in fourteen sections. Briefly they included:

The belief of the committee is that, owing to the geological formation found to exist, the dam never should have been constructed in San Francisquito canyon.

The failure of the dam was due to defective foundation material, some of which, while reasonably hard when dry, became soft and yielding when saturated.

That the softened rock was swept out from under the west wing of the great gravity arch causing that portion of it to collapse under the weight of 12,000,000,000 gallons of water.

That following failure of the west wing, the escaping waters whirled across the downstream sole of the dam, cut away the easterly wall and caused the east wing to collapse.

That examination of the foundation material supporting the central section of the dam, which still stands, shows a fracture in the formation indicating that the rupture which permitted the downstream movement, occurred in the foundation material and not in the concrete of which the dam was built.

That the gauge installed in the reservoir showed the level of the water dropped .005 foot on the day before the break despite the fact that no water was drawn from the five-mile lake during this period.

That the drop of the water from 8 P. M. to 11:30 P. M. on March 12th was thirty-five thousandths of a foot or 534,580 cubic feet—a discharging rate of 74 cubic feet per second. The dam collapsed a few minutes before midnight on that day.

## W. A. Slater Made Research Professor of University

At the meeting of the Board of Trustees of Lehigh University on March 13, Willis Appleford Slater, Engineer Physicist in the Bureau of Standards, Washington, D. C., and Chief of the Section on Masonry Construction, was elected Research Professor of Engineering Materials and Director of the Fritz Engineering Laboratory in the Department of Civil Engineering. With this appointment it is hoped that an intensive program of scientific research in the materials of engineering can be undertaken by the University in an effort to extend its knowledge of such materials.

At the outbreak of the war in 1917, Professor Slater was called to the Bureau of Standards as Engineer Physicist and detailed to the Emergency Fleet Corporation in connection with the design, construction, and testing of reinforced concrete ships. A part of the experimental work connected with this study was done at Lehigh University. As a result of Professor Slater's work in this subject, he was awarded the Wason Medal of the American Concrete Institute in 1920. After the war Professor Slater continued with the Bureau of Standards in charge of investigations in reinforced concrete. For a time he was on leave from the Bureau as the owner's representative on the construction of the $2,000,000 football stadium at the University of Illinois.

Professor Slater participated in what was said to be the first test made to determine the actual stresses in a reinforced concrete building in actual service by measurement of the strains in the floor. He has participated in many of the important tests of actual structures which have since been made. One of his most spectacular investigations was conducted in 1925 when he was placed in charge of the construction and tests of an experimental arch dam of unreinforced concrete known as the Stevenson Creek Dam in the mountains of California.

# *Organizations*

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth St., New York City.

American Road Builders' Association; Miss E. A. Birchland, Secretary, 29 W. Thirty-ninth St., New York City.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; Wharton Clay, Commissioner, 123 W. Madison St., Chicago.

Association of Cast Stone Manufacturers; Frank M. Brooks, Secretary, Pasadena, Calif.

Building Officials Conference of America; H. E. Plummer, President; Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Concrete Products Association; F. O. Matthiessen, Secretary, 644 Drexel Building, Philadelphia, Pa.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Iowa Concrete Products Association; Floyd Goodrich, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President; A. W. Dickson, Executive Secretary, 2226 Builders Building, Chicago, Ill.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 E. Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 E. Twenty-second St., New York City.

The National Lime Association; G. B. Arthur, Secretary, 927 Fifteenth St., N.W., Washington, D. C.
1928 Convention, Belmont Hotel, New York City, May 23-24.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

Northwest Concrete Products Association; F. R. Zaugg, Executive Secretary, 803 Seaboard Building, Seattle, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; E. B. Bushnell, Secretary-Treasurer, 425 E. Water St., Milwaukee, Wisconsin.

# Mixer Musings

**Reported by "Joe"—The Mixer Boss.**

## About a Lot of Things

YOU fellows want to be sure to read that letter of P. G.'s published up front somewhere. There is an old contractor after my own specifications. That bird could no more keep his hands out of the contractin' business than I could sell life insurance.

There are fellows like that. Get so darned wrapped up in the work they have been doing that they can't drop it when they make their pile. Wish I had a chance to show folks how quick I could drop this job of Slump Tester secretary job and play golf in California, instead of visiting construction jobs like this P. G. guy is doing.

And there is a lot of downright common sense in the things he is talking about. Even I know from my experience that too much contractor's equipment is bought by guess-and-by-gosh. Wonder what his next letter is going to be about.

The editor tells me that P. G. is going to write some more letters. I know I for one am going to look for them. Maybe I can get old P. G. to make application for membership in the Guild. Bet he's made a lot of slump tests.

* * *

Say, there is a lot of interesting stuff that comes into the office of a paper like this. When they can't find place for the stuff up in front of the paper, they pass it on to me. Here is a little jingle that came in the other day and it fits some of these so-called concretors in the products game. You know some fellows just simply won't play the game with the other fellows in the same line of business. They can't see any use in belonging to associations or attending conventions or trying to work for the good of the industry at all. Well, this little rhyme tells you all about such guys.

When I am alone, and quite alone,
I play a game that is all my own;
I hide myself behind myself,
And then I try to find myself;
I hide in the closet where no one can see,
And then I start looking around for me.

—Ain't he got fun?

* * *

I wish we could make this column a sort of a clearing house for all sorts of sense and nonsense that has some sort of application—either near or remote—to this concrete game. You fellows out on the job run into a lot of little instances that give you a laugh or at least a chuckle. Why not pass it on to the rest of the guys that might appreciate the joke even more than you did?

Make this your column. Send in your stuff. And remember it's gotta be good or it doesn't get published.

For instance, today somebody calls me up and says that Bill Allan has bought a brand new derby hat! *That's news!*—and additional comment is unnecessary. But we can't refrain from saying that we always have said that the concrete products industry is getting in the class of big business.

Who's got the first contribution?

***Joe,*** the Mixer Boss.

# New Equipment and Materials

## Slide-Lock Mold for Test Concrete

A new mold recently made available generally has been developed by the Fisher Scientific Company, Pittsburgh, Pa. It is made of a grade of steel most adaptable to the purpose and is open at both ends and split on one side throughout its entire length. Heavy dovetail guides, one on each side of the seam, form a lock, while the slide with handle attached is the key which draws and holds the mold together with the seam entirely closed. The manufacturers point to the simplicity of removing the mold, since when the seam is unlocked, the mold automatically springs open.

The mold is available in two sizes, one 6 inches in diameter by 12 inches and the other 8 inches in diameter and 16 inches high.

A heavy sheet steel plate has been devised to transport the mold when filled.

## New Tousley Surfacer Has High Cutting Speed

The Tousley Tool Company, Cleveland, Ohio, has recently developed a new lightweight concrete surfacer known as its No. 7-A machine. It weighs 9 pounds fully equipped, requires 30 cubic feet of free air per minute and is exceedingly easy to handle from scaffolding or ladders, the manufacturers say. It has a high cutting speed which materially increases the amount of surface that can be finished within a given time.

The machine is closely coupled, the operator's hands being close to the work which gives him positive control at all times.

This company has also brought out a steel cutter head for quickly smoothing rough concrete.

## Toxmix Accelerates Set of Floor and Road Surfaces

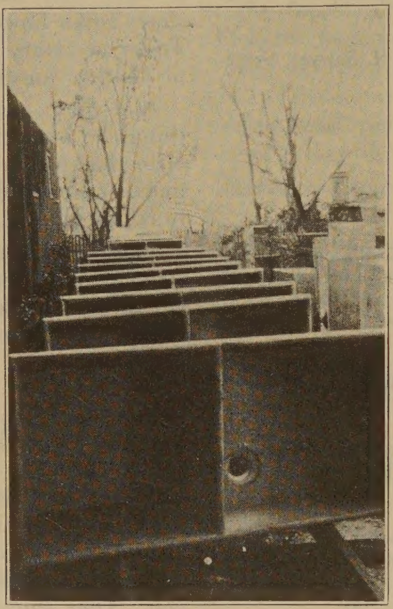
Where it is necessary to accelerate the set of the floor in order to give it an earlier finish than usual, Toch Brothers suggest the use of R. I. W. Toxmix Clear. It is incorporated in the mix for the purpose of giving a thorough, complete hardening action throughout the topping.

Its use is suggested also in road construction, where, the manufacturers say, a greater compressive as well as tensile strength is obtained.

Toxmix is also furnished in colored form, and as a powder, instead of the liquid used for floor finishing.

## Pattern for Sand Molding of Specialties

A method of molding in sand such products as flower boxes, burial vaults, septic tanks, ash receptacles, and laundry trays has been developed and patented in the East.



The pattern is placed on specially prepared sand which is then well packed inside and out. Upon withdrawal of the pattern, a complete mold is obtained, ready to be poured. A 1:3 mix is advised, with waterproofing added according to the manufacturer's directions. Following the hardening of the concrete, the molding sand is brushed off with wire brushes. The molding sand may be used again and again.

Laundry trays made by this process are shown.

The pattern patent is held by Antonio Galante, Medford, Mass.

## Armstrong Corkboard Used as Joint Filler

Corkboard for use as a joint filler is being recommended by the Armstrong Cork and Insulation Company, Pittsburgh, Pennsylvania. It is claimed that Corkboard fills the need ideally, since it is said to be as nearly non-absorbent of moisture as such material can be, withstands compression without taking a permanent set, returns to its original volume when compression is removed, and does not soften or run in hot weather.

## Traveling Saw Arbor on New Rig

### *Features Tilting Steel Table Top*

A traveling saw arbor which will do double mitering, bevel ripping, rabbeting, or any kind of sawing in addition to ordinary cross-cutting and ripping, is a feature of the Power Sawyer, a new portable sawrig recently placed on the market by the Marsh-Capron Company of Chicago. It has been so designed that full sawing force is applied evenly to the wood from the start to the finish of the cut.

Any kind of a cut that can be made by hand saw or any sawrig can be made with the Power Sawyer, it is claimed. It has a tilting table top, adjustable saw arbor, excess power, safety guards, sawdust chute, and 14-inch cross-cut and rip saws as standard equipment. Twelve-inch or 16-inch saws can be used if desired.

For mitering and beveling the steel table top can be tilted to any angle up to 45 deg. and clamped into position by a quick turn of a hand screw. On shallow cuts, 1 inch and 2 inch, the arbor tracks can be quickly adjusted to the proper height. Although the saw arbor has a speed of 2400 r.p.m., it is said it cannot overheat or "burn up." Twelve Timken roller bearings are used. When necessary the saw arbor can be held stationary in any position, and by lowering or raising one end of the arbor tracks, a cut of any depth can be made with a saw or with a dado head.

Eight to 10 h.p. LeRoi or Novo engines, or 5 or 7½ h.p. electric motors are standard equipment for the Power Sawyer. The engine is mounted on the same frame members as the sawrig, and the whole frame is electrically welded to produce an extremely rigid, heavy-duty frame. A floor space of 36 by 77 inches is required for the whole outfit, engine and all.

Ten to fifteen per cent more speed than secured with other types and ability to make heavy cuts as high as 2 by 16 inches are claimed to be possible with the horsepower provided for the Power Sawyer.

# About Makers of Equipment and Materials

## INDUSTRIAL LITERATURE

### *"Rock Drilling Projects"*

A book of reprint articles covering a number of drilling jobs in 1927 recently has been issued by the *Ingersoll-Rand Company*, New York City.

The book was issued to fill the numerous demands of contractors for descriptive data of recent important projects. Included in the collection are articles on the Cascade Tunnel, of the Great Northern Railroad, the Chicago Intake Tunnel, the Conowingo Dam, Strengthening Power Dams in the Alps, Extending New York City's Subways, Vermont's Varied Marbles, etc. These articles are bound together in an attractive two-color cover of heavy stock.

Copies of these booklets may be had by writing to any of the Ingersoll-Rand branches, or to the main office in New York.

### *Incor Available*

Announcement of the availability of *Incor* cement is made in a 12-page booklet published by the *International Cement Corporation. Incor* is a 24-hour portland cement of the quality of *Lone Star.*

While the product has been perfected only recently, its use in numerous instances is described and pictured.

### *Quickard Booklet*

The use of the new twenty-four hour hardening cement product of the *Ash Grove Lime and Portland Cement Company,* known as *Quickard,* is described in a twelve-page booklet just issued. Its use in railway work is illustrated and test results are reproduced.

### *Stucco Color*

A color card issued by *George S. Mepham & Company,* East St. Louis, Illinois, carries a formula sheet to be used in mixing concrete colored with the Mepham product. One group of chips is intended for use in matching stucco and another for floors, steps, walks, block facings, tile, etc.

### *Inertol Waterproofing*

For preserving concrete against the inroads of water when it is so subjected, the *Inertol Company,* New York City, suggests the use of Inertol, a paint-like compound, in a recently published four-page folder.

*The Inertol Company* was known until recently as the Paul Lechler Company.

### *Miami Hydro-Plastic*

*The Southwestern Portland Cement Company* introduces its high early strength cement, known as *Hydro-Plastic,* in a 4-page broadside entitled "Progress." *Hydro-Plastic,* according to the publication, insures plasticity, and protection against water, oil and acid.

### *Pipe and Conduit Process*

What are said to be three proven processes for the manufacture of as many concrete products are described at some length in Bulletin 3, under date of April, 1928, of the *Asphalto-Concrete Corporation,* New York City. The company controls the rights on a drain and pressure pipe system known as the *Moir-Buchanan,* one for asphalt lining and surfacing known as the *Billé-Ligonnet* process, and the *Contractor* system of concrete pole and conduit manufacture.

In describing the *Moir-Buchanan* process of pipe manufacture, the publication mentions that it is a combination of the centrifugal and mechanical action, spinning being done at a compartively low speed. A demonstration plant located in New York State is pictured.

The method of causing concrete and asphalt lining in pipes to adhere to each other by using a binder such as stones is in short the *Billé-Lingonnet* process. Both pipe and flat surfaces may be waterproofed by this process.

The Swedish *Contractor* method of pole and conduit manufacture, described somewhat briefly, is well illustrated.

## NEW EQUIPMENT

*(Continued)*

### Paver Used with Portable Conveyor

A MultiFoote 27-E paver was used in an ingenious arrangement of a paver and a portable belt conveyor in California recently for placing concrete on the Los Angeles County flood control work in the Verdugo Wash. Approximately 45 tons of material are said to have been poured per hour using only the two pieces of equipment.

In doing the work the floor of a concrete-lined channel, 3400 feet long and 47½ feet wide, was first laid using a MultiFoote 27-E paver. As the work progressed, the reinforcements were placed and the forms set in position for the 8-foot perpendicular side walls. After the floor was finished, a portable conveyor was hooked up to the paver, and a large hopper was installed at the lower end of the conveyor.

The concrete from the mixer was discharged directly into this hopper. Six-inch slump concrete was then conveyed direct from the paver into the wall form by means of the conveyor. The arrangement worked steadily at maximum capacity without trouble and eliminated the need for wheelbarrows, carts, chutes, hoists, and other equipment usually used on jobs of this sort. The conveyor was trailed by the paver in changing position, and the combination of paver and conveyor was both mixing and delivering plant.

## Notes from the Field

### *Smith Representative*

*The T. L. Smith Company,* Milwaukee, Wis., manufacturers of Smith mixers and pavers, announce the appointment of the *R. P. Sweeny Company* of Greenville as their representatives for the entire state of South Carolina, with the exception of Chester, York, Lancaster, Chesterfield and Marlboro counties.

### *Solvay Removal*

*The Solvay Sales Corporation* has removed its Chicago branch office to 222 West Adams Street.

### *Carbic Sales Agents*

The *Carbic* acetylene floodlight and the Carbic acetylene generator, as well as other Carbic equipment utilizing acetylene, formerly sold by the *Carbic Manufacturing Company,* Duluth, Minn., will in the future be distributed exclusively by the *Oxweld Acetylene Company,* 30 East 42nd Street, New York.

The processed carbide in cake form, sold under the trade-mark Carbic, for Carbic lights and generators, will be distributed exclusively by the Union Carbide Sales Company, New York, through its nation-wide chain of warehouses.

# About Makers of Equipment and Materials

## NOTES FROM THE FIELD

### *Silica Merger*

*The Ottawa Silica Company* of Ottawa, Illinois, has acquired the complete plant and property of the *United States Silica Company,* also located at Ottawa, Illinois, and will operate it under its own management.

*The Ottawa Silica Company* already operates two plants in the Ottawa district and with the addition of the United States plant, which has recently been remodeled and enlarged, it will have one of the largest capacities in the country for producing white silica sand.

It is planned to continue operation of all three mills and to make the various brands of sand already established.

In order to maintain closer touch between the operating and administrating departments, the general offices of the company will be located at the mills, at Ottawa, Illinois.

### *Milcor Fireproof Division Appointments*

Due to rapid growth the Fireproof Material division of the *Milwaukee Corrugating Company* is enlarging its production facilities and increasing its sales force.

The recent addition of *Julius A. Pfeiffer* as director of sales of the Fireproof Material division has already been made.

*H. B. Spackman,* formerly of the Northwestern Expanded Metal Company, has been appointed special representative; *C. C. Banholzer* has been assigned to the Wisconsin and northern Michigan territory; *J. G. Decker* will have his headquarters at Minneapolis and will take care of the northwestern territory, and *G. C. Lendon* has been assigned to the Detroit territory.

### *Tramrail Representatives for New York*

*The Cleveland Electric Tramrail division* of the *Cleveland Crane and Engineering Company,* Wickliffe, Ohio, announce the appointment of *Leeds, Tozzer and Company,* Inc., 75 West Street, New York, N. Y., as representatives of their Tramrail system in Manhattan, Bronx and Staten Island, New York.

### *Western Brick Sales Manager to Promote Haydite*

*Henry A. Guthrie,* for many years identified with various phases of the building industry in a promotional way, has been appointed general sales manager of the *Western Brick Company,* according to an announcement by Frank W. Butterworth, general manager of the company. Mr. Guthrie leaves the George L. Dyer Company, advertising agency, to take charge of sales for Haydite and brick.

Mr. Guthrie will have his headquarters as general sales manager of the *Western Brick Company* in Suite 1604, Builders' Building, Chicago. In addition to directing the sales of face brick, Mr. Guthrie will devote a portion of his time to the promotion of *Haydite,* the light-weight concrete aggregate.

## INDUSTRIAL LITERATURE

### *Solvay Publication*

*The Solvay Sales Corporation* is responsible for the publication of a 32-page booklet containing paragraphs such as "Greater Strengths Through Proper Curing," "Early Strength and Acceleration," "Waterproofing," "Effects of Calcium Chloride on Reinforcing," and "Lower Water-Cement Ratio."

There are illustrations of several dozen structures in whose construction calcium chloride was used.

### *Celite Folder*

*"Designing Concrete for Workability as Well as Strength"* is the title of an eight-page folder published by the *Celite Products Company.* Three slump test illustrations show the effect of the use of admixture on cylinders. A page is devoted to the method of testing workability.

### *Jaeger Publication*

*The Jaeger Machine Company,* Columbus, Ohio, has published *Catalog No. T 28* on its tilting type mixers. The "quick index" on the left of Page 2 will be found practical.

The catalog makes a feature of the aluminum mineral paint used on 1928 *Jaeger* mixers. Beside mixers there is described such equipment as placing plants, pavers, contractors' pumps and hoists, special attachments such as water tanks, skip shakers, spouts, batch-meter, and similarly related devices.

### *Knickerbocker Catalog*

A few words on "How the Knickerbocker Mixer is Designed and Built" launch the *Knickerbocker Company's Catalog No.* 28 well on its way. Descriptions which follow of parts and of the machine as a whole tell how they help to produce concrete of a consistency that meets the engineer's specifications.

A page or more is devoted to each of the following: drum end control, the drum and its discharge, the system of accurate water control, as well as short descriptions, under the heading "How the Knickerbocker Eliminates Trouble," of the designs of parts such as cable sheaves, clutches, batch meter, truck frames, etc.

The 1928 mixer is vividly illustrated on a two page spread.

*The Knickerbocker Company* is located at Jackson, Michigan.

### *Wert Products Booklet*

The complete line of *Wert* concrete products machinery is catalogued in a 16-page publication issued by *C. S. Wert,* Kendallville, Indiana. It includes models of brick machines, power tamper, ornamental and face brick machines, chimney block machine, block machine, floor tile machine, and silo stave molds.

### *Silent Hoist Publication*

A four-page loose leaf folder known as *Bulletin* 27 published by the *Silent Hoist Winch & Crane Company,* Brooklyn, New York, describes the different types of vertical and horizontal capstan winches and single and double drum winches, self-contained units complete with electric motor and gasoline drive.

While no detailed specifications or data of sizes of the various styles, etc., are contained in the folder, illustrations are profuse.